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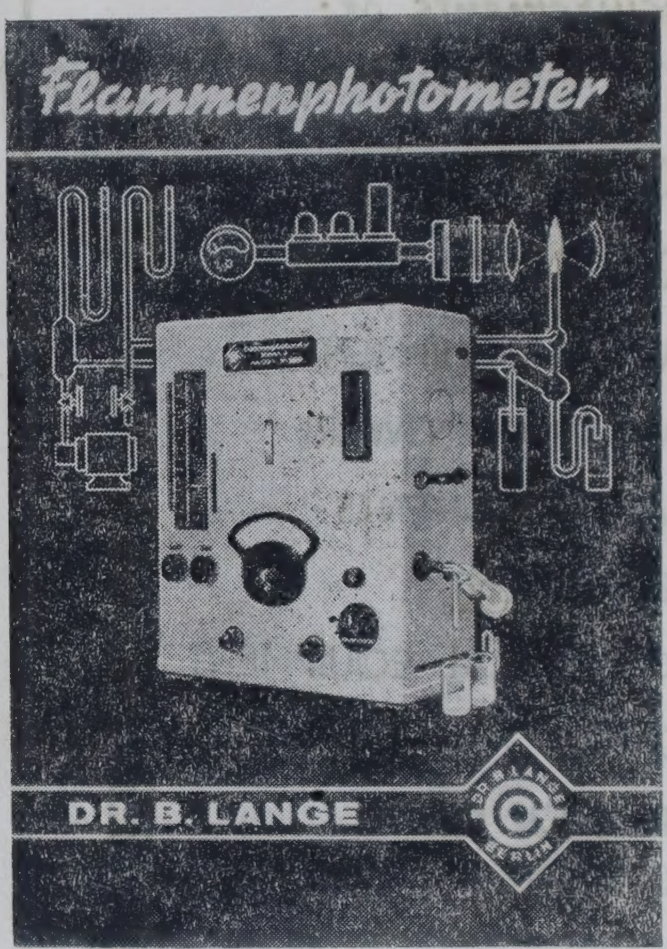

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ANNUAL REVIEW OF BIOCHEMICAL AND ALLIED RESEARCH IN INDIA

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CONTENTS*

		Page
1.	Soils and Fertilisers *S. P. Raychaudhuri and B. V. Subbaiah* ...	1
2.	Plant Physiology *R. D. Asana* ...	18
3.	Enzymes *A. L. N. Prasad and K. V. Giri* ...	28
4.	Chemistry of Plant Products *B. H. Iyer* ...	34
5.	Vitamins *D. V. Rege and A. Sreenivasan* ...	48
6.	Food Technology *S. Balakrishnan and R. Rajagopalan* ...	57
7.	Human Nutrition *A. R. Sundararajan and K. K. Bagchi* ...	61
8.	Human Pathology *A. K. Basu* ...	70
9.	Dairy Science *K. K. Iya & H. Laxminarayana* ...	92
10.	Animal Nutrition *S. C. Ray* ...	101
11.	Microbiology Including Antibiotics *P. N. Nandi* ...	108

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SOILS AND FERTILISERS

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Department of Chemistry
Indian Agricultural Research Institute, New Delhi

Physico-chemical properties of clays and clay minerals

As in the previous years, considerable attention has been given to the identification of clay minerals. Mitra *et al* [1] observed that electron microscopy reveals a rod like habit of halloysite in contrast to the hexagonal plates of its close chemical analogue kaolinite. Electron diffraction patterns of these two clays obtained in transmission with normal beam incidence are also significantly different and not only distinguish clearly between these two but also enable halloysite to be identified with certainty. The innermost ring in the halloysite pattern corresponds to the characteristic (001) basal spacing of 7.4 and this ring is not present in the pattern obtained by kaolinite.

A new method of determining the dominant clay mineral in a soil has been reported from its reflectance spectra by Viswanath and Ramamoorthy.[2] They have shown that light reflectance curves of ignited soils could be used to determine the dominant mineralogical composition of their clays. Soils with kaolinite as the dominant clay mineral are characterised by high values, those with montmorillonite by low values and those of illite taking intermediary values. Roy and Das [3] working on electro-chemical properties of hydrogen clays from typical Indian soils, observed that clay minerals and clay fractions of various soils may be differentiated by their potentiometric titration curves, by the base exchange capacity values or ratios and the position of inflection points, as well as by the change in viscosity of aqueous suspensions of H-clays on addition of NaOH. They found from the electro-chemical properties of H. clays isolated from soil profiles in different localities in India, and mineralogical examinations that the montmorillonite

1 Mitra, R. P. *et al*, (1951), Nature, **168**. (380).

2 Viswanath, B., and Ramamoorthy, B (1951), Current Sci., **20**, 20.

3 Roy, B. B. and Das S. C. (1950), Fourth International Cong. Soil. Sci., **3**, 81.

group predominates in the clay fraction of black cotton soils and kaolinite group in that of lateritic and acid soils. The black clay fractions may also show some illite while some halloysite might be associated with red clay fraction. The base exchange capacity and differential thermal analysis studies of some representative samples of Mysore clays by Narasing Rao[4] *et al*, with a view to finding out their mineralogical composition, indicated that the samples from Gullahalli, Bageshpur, Tirthahalli belong to kaolinite group while one from Gallohalli was halloysite and Hebbur samples might be kaolinite with small amounts of montmorillonite.

Mukherjee, Mitra and Bagchi[5] studied the electrochemical character of Hydrogen clays in relation to their mineralogical composition and found that clay minerals impress their characteristic electrochemical and related properties on hydrogen clays from soils of which they form the dominant constituents and an identification of these constituents was therefore possible from a comparison of the features of the ensemble with those of the pure clay minerals. Bagchi[6] studied the mineralogical composition of clay fractions from a number of typical Indian soils, kaolins and bentonites by X-ray diffraction technique and correlated with their electrochemical properties. The thermal dehydration and refractive index studies[7] of clay fractions isolated from typical Indian soils, kaolins and bentonites for identification of clay minerals contained in these exhibited a close correlation between the mineralogical make up of clays as obtained by these physical measurements and their electrochemical character.

Mukherjee[8] reported the results of his studies on the symmetry values and the mineralogical composition of the clays. A comparision made of the symmetry values of one kaolinite and two montmorillonite clays against different cations showed that the

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4 Narasinga Rao, M. S. *et al*, (1951) Current Sci., **20**, 12, 323.

5 Mukherjee, J. N., Mitra, R. P. and Bagchi, S. N., (1951) Ind. Soc. Soil Sci. Bull No. 6, 1.

6 Bagchi, S. N. (1951) Ind. Soc. Soil Sci. Bull No. 6, 19.

7 Bagchi, S. N. (1951) Ind. Soc. Soil Sci. Bull No. 6, 422.

8 Mukherjee, S. K. (1951) Ind. Soc. Soil Sci. Bull No. 6, 89.

montmorillonite clays (one of these contained a little illite) behaved alike in their exchange properties as revealed by symmetry values but different markedly from the kaolinite clay. The kaolinitic clay showed a greater release of monovalent cations and a smaller ease of replacement of bivalent cations compared with the two montmorillonitic systems. An Al clay prepared from kaolinitic clay gave, however a greater symmetry values against various cations compared with montmorillonitic clay.

Electrochemical, electroviscous and thermal dehydration studies of the clay fractions from different horizons of black soil profile from Indore and another soil profile from Delhi were carried out by Roy[9]. His results show that the clay mineral in the black soils is predominantly montmorillonite, but illite to the extent of 20-30% was also present. Clays from the Delhi soil profile are mixtures of illite and montmorillonite, the proportions of latter gradually increasing with depth.

Chatterjee and Datta[10] studied the phosphate fixation by clay minerals montmorillonite and kaolinite by the method of Truog and Meyer on H-systems. They found that H-kalonite showed at low pH a greater phosphate fixing capacity than H-montmorillonite, the relative differences decreasing with increasing pH and being reversed in the pH region of 7 to 9, possibly due to the exchange between P ions in the solution and OH ions of the crystal lattice rather than due to greater activity of Fe and Al in kaolinite while the increasing fixation of H-montmorillonite with time and higher pH might be due to precipitations of free inorganic oxides. Increasing fixations with decreasing particle size may be due to greater availability of OH ions in kaolinite and by a greater accumulation of free oxides and the increase of OH ions on the edges and of the exchangeable Al on the surface of mont morillonite crystals.

Mukherjee, De and Venugopal Rao[11] studied the cation exchange in Homionic clay salts and obtained the following

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9 Roy, B. B. (1951) Ind. Soc. Soil Sci., Bull No. 6, 121 to 123.

10 Chatterjee, B. and Datta, S. (1951) J. Soil Sci., 2, 224-233.

11 Mukherjee, S. K., De, R. M., and Venugopal Rao (1951) Indian Soc. Soil Sci., Bull No. 6, 67.

results:—(1) except the Al-clays, the aqueous suspensions of the clay salts had an alkaline reaction (pH 8.01 to 9.74). (2) The relative exchange powers of the varions cations as indicated by symmetry values of a given clay salt against these cations could be arranged in the form of lytrope series. However, there were certain peculiarities like Mg having usually a greater effect than Ca, the H-ions occupying a variable and anomalous position in the series and NH_4 and K often interchanging their positions. A better agreement with lytrope series could be obtained where the symmetry values of the different clay salts against a given cation was considered. (3) The symmetry values increase with diminishing pH due to an increasingly greater part played by H-ions in the exchange, the concentration of the metallic ions remaining constant. The symmetry values are in agreement with lytrope series at higher pH values (6.0 and 7.0) but at lower pH values (5.0 and 3.0) a constant symmetry value against all the cations was obtained and the lytrope series apparently was found to vanish. However, the amounts of the cations entering the complex in competition with the H-ions have been found in an experiment with an Mg-clay to follow the lytrope series, showing that the lytrope effect is present even at low pH values. (4) Chlorides gave higher symmetry values than the corresponding acetates. (5) Assuming that a time equilibrium was attained, the sum of the symmetry values of the two balanced reactions should be 100.0 but it was as a rule, greater than 100 where chlorides were used but always less than 100.0 in the case of acetates. These discrepancies arise from an exchange of varying amounts of the 'residual' H-ions for the added cations.

Mukherjee [12] further made a comparative study of the base exchange equation and of the exchange isotherms in the light of exchange measurements. The constants K_w and K_R in the equations of Wiegner and Renold respectively were found to have fairly constant values over a range of concentrations, but the constants K_J and f in the equation of Jenny and Bray respectively showed marked variation with concentration, the more so when monovalent cations were exchanged for bivalent cations. Relations

12 Mukherjee, S. K. (1951) Indian Soc. Soil Sci. Bull No. 6, 96.

beween K_J, f and symmetry values using these relations were different from those calculated from the different points of exchange isotherms. The values of m_P and m_P *i.e.* the average values of K_R and K_W followed the lytrope series when calculated for the exchange of cations from a given clay salt against various cations. The lytrope series was found to hold good even at extremely low concentrations of the added electrolytes as judged from the values of the constants pC and (C) $\frac{1}{2}u$ in Pallman's equation. He further discussed the role of adsorption of cations in cation exchange as influenced by the valency, size, mobility, hydration, and polarisability of the cations and pointed out the inadequacy of current theories including the above equations in depicting the exchange data pointed out. Mukherjee and Venugopal Rao [13] found that turbidities of colloidal solutions of the homoionic clay salts measured using the Zeiss's Trubungsmesser followed lytrope series, *i.e.* the stronger the adsorption of the cation the greater was the turbidity. The turbidity of Ba/NH_4 bentonites having different proportions of the two cations increased with an increase in the proportions of the strongly adsorbable Ba-ion and at the same ratio of Ba to NH_4, the NH_4-Ba-bentonite (1) has a higher turbidity than Ba-NH_4 system (11) indicating agreement with the exchange data, a strong binding of Ba in (1) than in (11).

Soil classification and soil survey

Typical profile descriptions and mechanical composition of red and lateritic soils of India were given by Raychaudhuri.[14] Red loams and earths which together occupy about 200,000 sq. miles, are porous, free from lime 'Kankar' and carbonates, low in soluble salts, of neutral to acid pH and are deficient in N, P, lime and humus. They differ greatly in depth and fertility and produce large variety of crops both under rainfed and irrigated conditions. The lateritic soils covering 50,000 sq. miles are deficient in P, K and lime, thin or gravelly at higher levels

13 Mukherjee, S. K. and Venugopal Rao (1951) Indian Soc. Soil. Sci. Bull N. 6, 116.

14 Raychaudhuri, S. P. (1950) Tran. Fourth Internal. Cong. Soil Sci. 3, 125.

and at other places range from heavy loams to clays. They produce good crops, especially rice. It appears that the separation of iron oxide in the form of nodules or their gradual cementation to form an undurated honey combed mass is one of the characteristic features of this type of soil formation.

The characteristics of regular soils of India popularly known as black cotton soils were described by Tamhane[15]. They cover nearly 200,000 sq. miles of the southern half of India and are invariably derived from basic igneous rock and belong in general to chernozem group. They show heavy cracking with vertical fissures extending to 4 to 5 feet in deep soils, are very low in organic matter, have no A_0 or A_{00} horizon, contain $CaCO_3$ throughout the profile, have brownish red B horizon especially in deep phase, often contain black shiny shot like objects, have a SiO_2/R_2O_3 ratio nearly 4, a pH of 7.3 to 8.9 or often a salt accumulation in deep soils. They are closely related to the "Black limp" of Africa and black earths of Australia.

Satyanarayna[16] conducted a very rapid reconnaissance soil survey of certain areas in the Rann of Cutch and described the general features, its location and extent, geological origin, physiography including floods or drainage conditions and climate. The soils were found to be generally heavy, contain high amounts of sodium and gypsum. *Glei* horizons occurred in four out of the 8 profiles studied. The water table was generally high. His studies indicate the possibility of reclaiming certain areas and economical recovery of gypsum.

The black cotton soils of the Madras Deccan according to Shiva Rao and Kashinathan[17] presented the major characteristics of the European chernozem but differed from it in important characteristics. They were found to be more like the formation of drier regions such as the steppe soils of the Hungarian low lands. Two modifications of the general chernozem process appear to have dominated the soil forming processes in the area, resulting

15 Tamhane, R. V. (1950) Trans. Fourth Internat Cong. Soil Sci., **6**, 131.

16 Satyanarayana K. V. S. (1950) Ind. Soc. Soil Sci. Bull No. 6, 125.

17 Shiv Rao, H. and Kashinathan, S. (1951) Studies on Soil Systematics J. Soil Sci., **2**, 61.

in the formation of soil types allied to the brown steppe and leached alkaline soils. They could not, however, present any reasons for the existence of these modifications. The investigations on soil classification, survey and mapping of black cotton soils in the canal zones of Bombay Deccan were carried out by Basu and Sirur[18] at Deccan Sugarcane Research Station. These studies included survey for soil classification and fertility grouping with detailed agronomic studies on important soil types. Twelve profile types were identified and grouped as immature tropical chernozems. The soil variation could be attributed mainly to topography through its effect on drainage.

Agarwal and Mukherjee[19] studied the pedochemical characters of the genetic soil types of the Gangetic alluvium of Gorakhpur District. Detailed mechanical, chemical and physico-chemical composition of the types of soil indicate their development from calcareous parent material. The low land type comprises of Ca-soils with ample reserves of soft lime throughout the profile. At higher levels, leached Ca-soils occur in which $CaCO_3$ nodules from a layer at the base of the profile. More thoroughly leached up land soils show degradations and consequent unsaturation.

The problems of pan formation in coastal soils were thoroughly investigated by Mukherji, Datta, and Mukherjee[20]. Lime, gypsum, and superphosphate containing calcium as the predominant ion were applied to the pan soils in coastal areas to see if the flocculating action of these chemicals could improve the structure of soils of the pan horizon. No conclusive evidence was obtained. Pan formation was found to be absent under deep rooted trees and they recommended growing of trees such as arecanut and cocoanut which grow well in the tract and are of economic value.

Physico-chemical

Puri[21] studied the effect of removing residual moisture from

18 Basu, J. K, and Sirur, S. S., 1950, Trans-Fourth Internat, Cong. Soil Sci., **3**, 186,

19 Agarwal, R. R. and Mukherjee S. K., (1951) Soil Sci., **72**, 21.

20 Mukherji, J. N., Datta N. and Mukherjee, S. K. (1950), I. J. A. S., **XX** Part IV.

21 Puri B. R., (1951) Current Science, **20**, No. 7, 180.

oven-dried soils on their physico-chemical activity. He first rendered the soil base-free by prolonged leaching with N/20 HCl and dried it to a constant weight at 110°C. The soil was 'activated' by heating at 200°C. and passing through it a stream of dried air for six hours continuously. This procedure increased the reactivity of soils towards alkalies and also increased hygroscopicity, probably due to greater pore space.

Ranjan and Kothiyal [22] studied the effect of trench manuring on the physico-chemical nature of the soil. Their results indicated that trench manuring resulted in greater moisture content, higher amounts of available and total N, total C, organic matter, available phosphorus and available potassium. The pH of the soil was also shifted towards the neutral point.

Preliminary studies on pH fluctuations in rice soils during the growth of rice plants by Karunakar and Daniel [23] showed that treated plots had a slightly higher pH than unmanure plots. The differences in pH between the treated plots themselves were not significant while the seasonal variations were well pronounced. The pH was maximum at start and at flowering stage, and minimum during growth and maturity periods. The trend of the pH curves indicates that it corresponds to definite growth factors of the rice plant.

The effect of organic-mulches on soil conditions and soyabean crop was studied by Verma and Kohnke. [24] In the middle west of U. S. A. where extensive cultivation of soyabean is an erosion hazard, mulches increased soyabean yields through conservation of water.

Abhyankar, Narayana and Daji [25] developed a modified Bouyoucos method for the estimation of moisture equivalents of soils. The modified method was found to be quick, easy of manipulation and to yield consistent results.

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22 Ranjan and Kothiyal, M. D. (1950), Ind. Jour. Agri. Sci . **XX**, Part II.

23 Karunakar, P. D. and Daniel F. L., (1950), I. J. A. S, **XX**, Part II, 173.

24 Verma, A. B. S. and Kohnke, H. (1951), Soil Sci., **72**, 149.

25 Abhyankar, U. S., Narayana, N. and Daji, J. A. (1951), Poona Agri. Jr. Vol. **4**, No. 4, 252.

Soil conservation and soil reclamation

The importance of soil conservation for maintenance of soil fertility and the need for soil reclamation for increasing the crop production have been stressed by many workers, Daniel and Varada Rajan [26-27]. Basu [28] found, in a sample survey in 1950 conducted in certain parts of Bombay, that 71% of the land was denuded partially or totally of which 32% was wholly unfit for crops. He found that the danger was on the increase and recommended well planned soil studies based on a correct classification of the soils, as a thorough understanding of their nature was an essential pre-requisite for the conservation of soil fertility over a long period by proper adjustment of water, manure and crop rotation. Raychaudhuri [29] emphasised the importance of taking measures for soil conservation. In the first place, he advocated the initiation of uniform methods of investigation in the provinces and states. He also recommended a central nucleus of training in modern methods of soil survey and land utilisation. In another paper, Raychaudhuri [30] discussed the problem as it exists in India today in different states. He recommended that, along with planning of prevention of soil erosion, a simultaneous programme to be carried out on live stock management, reduction of grazing by encouraging stock feeding, establishment of village wood lands and stopping of erosion in steep slopes by terrace cultivation, bunding or gully plugging. Much of the simple conservation practices such as ploughing in the contour, conservation of water by contour bunds, rotation, strip cropping, plugging of gallies, controlled and rotational grazing, putting of terraces where needed, if adopted, will go a long way in checking this erosion.

Basu, Rege and Gajendragad[31] studied the effect of field strip cropping system with crops resisting and not resisting soil

26 Daniel, F. L. and Varadarajan, S. (1951), Mad. Agric. Jour., **38**, 145.

27 Chelam, (1950). Indian Farming, **XI**, No. 6.

28 Basu, S. K., Presidential address to the Section of Agri. Sci. during 38th session of the Indian Science Congress.

29 Rachaudhuri, S. P. (1951). Science & Culture, **IV**, No. 7, 286-289.

30 Raychaudhuri, S. P. (1951). Indian Farming New Series, Vol, **I**, 24.

31 Basu, J. K., Rege, N. D. and Gajendra Gad, R. S. (1951). Poona Agri. College Mag., **41**, Bull No. 4, 248.

erosion, on losses of soil and run off. Their results indicate that it is possible to avoid serious losses of soil and rain water by selecting useful cover crops, such as *Matki* and groundnut and growing them economically by stripping them with cereal. This method of cropping would not only save the land from utter destruction due to loss of soil but also would help to meet the balanced requirements of cereal and pulses of an average individual.

Aiyadarai[32] suggested the use of groundnut for control of soil erosion because of its dense, flat vegetative growth. Its extensively developed root system and the numerous pegs formed after the commencement of flowering are useful in the prevention of different types of erosion.

Reclamation of waste lands and lands gone out of cultivation as a means of stepping up food production has been emphasised by Raychaudhuri[33]. The problem of saline soils in Bombay have been discussed by Basu[34]. Natural salinisation of soils takes place in Bombay State due to aridity and great soil depth, topography, impervious subsoil, salt bearing strata and periodical flooding by sea water. Surface incrustation mainly by Na_2SO_4 in the profiles are caused by irrigation in areas where saline subsoil exists within 4 ft. of the surface. The greater or less suitability of saline soils for cropping and methods for their reclamation and management depend upon the salt status of the A horizon and on whether the soil forming processes result in a compact A but porous B horizon or in the ultimate development of a compact B horizon also. Soils under irrigatien need to be classified on the basis of the nature and amount of soluble salts in the profile and the nature of B horizon.

Soil Microbiology

Ranjan and Kothiyal[35] conducted nitrification studies of different soil types with different manures and found that sandy soils that provide a good aeration due to large noncapillary pore space,

32 Aivadarai, S. G. (1951). Mad. Agri Jr. **Vol. XXXVIII**, 153.

33 Raychaudhuri, S. P. (1950). Indian Farming, **Vol. XI**, No. 9, 390.

34 Basu, J. K. (1951) Trans, Fourth Internal. Cong. Soil. Sci,. **3**, 169.

35 Shri Ranjan and Kothiyal, M. D. Proc. Indian Acad. Sci., **B33**, No. 5, 282.

should be regarded as the best for nitrification but they lose all their nitrogen content owing to leaching and poor water holding capacity. Soils that provide less amount of air but possessing greater retention of water are best suited for nitrogen fixation. They also provide greater surface for reaction. Finer soils are impervious to oxygen supply and as such are not well suited for rapid nitrogen fixation. All these different soil conditions could be improved with the application of green manures in clay soils and carbonaceous material in sandy ones.

Pathak, Shikhande and Mukherjee [36] studied the nitrogen fixing capacity of the different fractions of the soil and found that the finely divided material like clay has some physiological influence on the fixation of atmospheric nitrogen by azotobacter. The authors attribute this to greater surface exposed for the absorption of the nutrients and possible aid in fixation of nitrogen by replenishing the ions in the solution removed by growing organisms. The use of molasses and Mohua flowers as sources of energy for azotobacter has been studied by Daji, Patel and Kala[37]. Both molasses and Mohua flowers were found to serve as sources of energy for azotobacter but the amount of nitrogen fixed per gm. of material is much less than in the case of mannite. Mohua flowers which contain larger amounts of nitrogen than molasses fixed less amount of nitrogen. Even at low concentrations, molasses is less efficient than mannite.

Desai and Subbiah [38] showed that the cations are made more available because of nitrification and nitrate being the dominant anion accounts for the absorption of the cations. The chemical composition of a number of plants indicated a close relationship between nitrogen and cations observed. Hydrogen ion concentration appeared to be more in the plant sap having wide difference of nitrogen and cations.

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36 Pathak, A. N., Shikhande, J. G. and Mukherjee. S.K. (1951). Curr. Sci. **20**, No. 5, 130.

37 Daji J. A. Patel M. K. and Kibe M. M. (1951) Proc. Ind. Acad, Sci. **B**, **33**, No. 6, 322.

38 Desai, S.V. and Subbiah, B.V. (1951), Proc. Ind. Acad. of Sci. **XXXIV**, Sect. B, No. 2, 73.

Desai [39] emphasised the necessity of inoculating the legumes and pointed out that, by inoculation, the legumes such as berseem and lucerne could give as much as 1,000% increase in yields. Inoculation could be beneficial for legumes on eroded lands, as also for green manure crops in rice fields and for building up soil fertility.

Compost and sewage

Dhar and Ghildyal [40] conducted experiments on composting of plant material. The decomposition of organic matter under aerobic and anaerobic conditions showed that (i) a rapid rise in the temperature at the beginning of composting period with a slow downward gradient afterwards, the extra aerobic composts maintaining a high temperature, (ii) the oxidation of total dry matter and total carbon was minimum in extra aerobic composts and minimum in anaerobic ones and (iii) the nitrogen concentration increased progressively. A moderate amount of N was fixed in the straw compost.

Ranjan and Kothiyal [41] composted mango seed kernel which contains 0.96 to 1.4% of total N, and approx. 8.5% of crude protein. On composting it for two months, the nitrogen content rose to 3.17% and the use of composted mango seed kernel gave high significant yields and proved superior to farm yard manure.

Sewage

Talati [42] discussed the need for diverting all the sewage effluents for agricultural use. Pillai [43] observed that filtration of sewage through soils could promote the development of aerobic bacteria and protozoa.

Manures and fertilisers

Pretreatment of seeds in nutrient solutions as an immediate

39 Desai, S. V. (1951). Indian Farming, **1**, New Series, 31.

40 Dhar, N. R. and Ghidyal, N. P. (1951). Proc. Nat. Acad. Sci., India, Part I, Section A, **20**.

41 Shri Rajan and Kothiyal, M.D. Pro. Ind. Acad. of Sci. Sec. **B. 33** No. 5, 288.

42 Talati. (1950). Indian Farming, **XI**, 530.

43 Pillai, S.C. (1951) Current Sci, **20**. 75.

means of increasing crop production has attracted the attention of many workers (Narayan,[44]) Abhichandani and Ramiah[45] treated rice seed in nutrient solutions like M/2 K_2HPO_4 and K_3PO_4 and obtained increased yields to the extent of 21.7% and 15.4% respectively. At higher concentrations the yields obtained were lower than those of half molar concentration.

Chatterjee[46] stressed the importance of rapid chemical tests of soils in determining the fertiliser need of soils.

Tank silts offer a valuable source of manure. Sen and Das[47] reported the composition of a number of tank silt samples from West Bengal. Their findings indicated that tank silts would compare favourably with farm yard manure from the point of view of their nitrogen content. A considerable portion of nitrogen in tank silts was readily available for plant growth. Most of the tank silts were acidic in nature and rich in finer fraction than ordinary soils. With expected increase in the number of tanks in the country Sen and Das[48] pointed out that the availability of this material for manurial purposes would increase and would constitute a valuable source of manure for the exhausted soils of India. Venkat Ram and Srinivasa Pai[49] studied the fertilising value of tank silts. Addition of silt even at such low concentrations as 5 or 10% contributed to considerable increase in shoot length and dry weight of rice seedlings. At levels of 20, 25, 50, 75 and 100% silt concentrations, the dry weight of seedlings and shoot length remained almost the same as in the case of 15%.

The effect of tannery wastes on soil conditions and plant growth was studied by Harihara Iyer, Rajagopalan and Pillai[50]. They observed that as a result of impounding waste water from the tannery close to the arable land, the salts

44 Narayan, T. R. (1951), Madras Agric. Jour. **XXXVIII**, 100.

45 Abhichandani, C. T. and Ramaiah, R. (1951). Current Sci., **20** 27.

46 Chatterjee. (1951). Science and Culture. **16**. 391.

47 Sen, A and Das, B (1951). Sci. and Cult. **17**, No. 3, 93.

48 Sen, A. and Das, B, B. (1951). Indian Farming, New Series, **I**, 26

49 Venkat Ram, C. S. and Srinivasa Pai, K.V. (1951), Proc. Ind. Acad., **XXXIV**. Section B, 109.

50 Harihara Iyer, C. R., Rajagopalan R, and Pillai S. C. (1951). Curr. Sci. **20**, 187.

including toxic substances from the waste materials soaked through the soil and adversely affected the composition of the soil. Sivaraman [51] observed that growing of certain leguminous plants like *Glyricidia macullata*, *Calatropes giganta*, etc., on the bunds of the paddy fields could give the green leaf which if applied to paddy before transplanation at the rate of 4,000 to 6,000 lbs. gave increased yields from 10 to 40%. No adverse root or shade effect was noticed from these plants and a study of the root system showed that the roots penetrated deep into the soil leaving the shallow paddy fields unaffected. He recommended this as an ideal way of green manuring particularly to fields where two crops of paddy are raised.

Idnani [52] emphasised that human urine from a population of 350 million in India could give if properly conserved 1.75 million tons of nitrogen, 0.28 million tons of P_2O_5 and an equal amount in terms of potash as manure. He recommended two types of urinals for use in the houses and at public places. Pot culture experiments with wheat indicated that urine soaked materials like soil, sand, ash, saw dust, charcoal dust, etc. gave yields of grain and straw $2\frac{1}{2}$ to $3\frac{1}{2}$ times more than the control and proved superior to ammonium sulphate in their manurial value.

Ramaiah, Vachani and Abhichandani [53] reported that the efficiency of the deep placement of ammonium sulphate to rice was 2.5 times more than that of the surface application and there was an indication that the response for 20 lbs. N placed deep could be as good as 40 lbs. N applied at the surface. It was found by Lalchand Dharmani and Khartar Singh Lohara [54] that application of ammonium sulphate gave better results than farm yard manure with wheat crop and where a lower than higher dose of ammonium sulphate seemed to be preferable.

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51 Sivaraman, M. S. (1951). Indian Farming New Series, **No. 7**, 16.

52 Idnani, 1951, Indian Farming, New Series, Vol. I, No. 3.

53 Ramaiah, K. Vachani, M.V. and Abhichandani, C.T. (1951). Curr. Sci. Vol. 20, 227.

54 Lalchand Dharmani and Khartar Singh Lohara. (1950), Indian Farming, Vol. **XI**, 396.

For the best crop growth through manuring Karunakar[55] pointed out the necessity of continued application of fertilisers year after year to build up a reserve of plant food. By inclusion of organic matter in the schedule, the physical texture could be rendered optimum. Chatterjee[56] discussed the role of manures and fertilisers and emphasised the need for the attainment of proper balance between soil fertility and crop production by a suitable combination of manures and fertilisers. Govindarajan[57] pointed out that the effectiveness of phosphates on paddy is enhanced when applied on a leguminous green manure crop. He also stressed that delayed application of nitrogen and proper placement of phosphate are likely to give better results.

Roy and Thomas[58] studied the phosphate reserves in some old permanent pasture plots at Cockle Park. Their results indicated that 98% of the previously added but unused phosphate remained in the surface 8 inches of soil and thus was made available to the subsequent crop; where little or no P is applied for many years, a reasonable dressing of P fertiliser would be necessary. This would give an immediate response but the unused P would be quickly fixed thereby decreasings its availability. The treatment will have to be repeated annually for some years. Their studies confirmed the view that superphosphate was not a good source of P for that land.

Satyanarayana[59] worked out the factors, such as manure, irrigation and strain influencing the yield of paddy and suggested the areas where the yield could be raised by nearly 160% over the present yield.

Subbaiah[60] showed that in all seeds of different plants, like wheat, corn, oats, soyabean, navybean, cowpeas, mustard, cotton and tobacco, the ratio of the sum of nitrogen, phosphorus and sulphur and the sum of minerals (Na, K, Ca, Mg) expressed in

55 Karunakar, P.D. 1951. Madras Agri. Jour. Vol, XXXVIII, 45.

56 Chatterjee, Indian Farming, Vol. XI, 284.

57 Govindarajan, S. V. 1951, Mysore Agri. Jour. Vol. XXVI, No. 3, 64.

58 Roy, B. B. and Thomas, B. (1951), Emp. J. Agri. Sci., **19**, 175-184.

59 Satyanarayana, M. (1951), Mad. Agri. **38**, 442.

60 Subbiah, B. V. (1951), Current Science, **20**, 161.

equivalents tended to be constant (0.2). Thus an interesting observation was made that seeds high in nitrogen are also proportionately rich in minerals.

Minor elements

Ramamurthy [61] discussed the role of minor elements in soil and their effect on forage and feeding cattle with special reference to their significance as tracers of evolution of some complex organic structures as determined by application of Goldschnidt's law. He pointed out to the gaps in the present knowledge of biological inter-relationships and antagonisms of the trace elements. For instance, there are certain animal deficiency diseases of Cu and CO which plant analyses for these elements do not reveal unless there is an understanding of the elements which antagonise them and of these related. The application of Goldschnidt's law to the replacements of atoms and ions in complex crystal structures (in the form that such replacements are possible only where the size of the atoms concerned agree within 10% of each other) coupled with a knowledge of the changes in valency and oxidation reduction systems involved, has been shown in this paper to elucidate many of these relationsips and antagonisms. The essentiality of Cu and CO for haemoglobin formation, the cause of anaemia due to their deficiencies and how they are antagonised by MO are shown as also the essentiality of MO for N fixation and the antagonisms between Cu and Pb in the Swayback diseases. The essentiality of Fe, Cu, Mn and Mg for chlorphyl formation and the possible steps in the evolution of chlorphyl and haemoglobin from cytochrome by the combined action of intermediary metal atoms have been traced along with biological antagonism between Se and S. A consequence of this is of greater importance of Mo for leguminous plants compared to others with tendency for the deficiency in cattle of Cu in countries where legumes and the like are extensively grown.

Dhawan, Jagjiwan Singh and Bhatnagar [62] studied the effect

61 Ramamurthy, B. (1951). Proc. Ind. Acad. **XXXIV**, 46-54.

62 Dhawan, C. L., Jagjiwan Singh and Bhatnagar, B B. (1950) Ind. Jour. Agri. Sci. XX, Part III, 343.

of exchangeable bases and pH on the oxidation of manganese compounds in soils. The oxidation was found to proceed even in acid soils. There was little or no oxidation in Na and K soils at pH 7.0. The effect of pH on the oxidation of manganese compounds in the case of calcium soils was very little. The nature of the base and pH value affect the oxidation of manganese compounds in soils.

Innes [63] found no obvious relationship between the incidence of unknown disease of the coconut palm in Jamaica and the manganese content of palm leaf tissue. In the spectrochemical determination of manganese in soils, Dakshinamurti and Rama Murthy [64] have shown that great care is to be exercised in the standardisation of the base as well as in the selction of the spectral line as there was an interaction in the intensities of lines belonging to different elements.

63 Innes, R.F. (1950) Cocoanut Jour. III, No. 3, 173-180.

64 Dakshinamurti, C. and Rama Murthy, B. (1951) Curr. Sci. **20**, 216.

PLANT PHYSIOLOGY

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The review relates to results of physiological investigations published during 1951. The investigations deal mainly with problems of mineral nutrition, developmental physiology, growth regulators and water requirement.

Mineral Nutrition

Lal [1] describes the effects of nitrogen deficiency on the growth and metabolism of sugarcane. Due to nitrogen deficiency growth was stunted; leaf size and tillering were also reduced. The rate of photosynthesis was lowered and uptake of phosphorus and potassium also diminished along with that of nitrogen. Partial nitrogen deficiency, however, increased sucrose content and improved juice quality.

In another contribution Lal and De [2] give an account of the composition at maturity of various elements in the leaf and stem of sugarcane under nitrogen deficiency. Due to nitrogen deficiency N/P_2O_5, N/K_2O, N/Ca, N/Mg, N/S, K_2O/P_2O_5, Mg/P_2O_5 and S/P_2O_5 ratios in the leaf and N/P_2O_5, K_2O/P_2O_5, Ca/P_2O_5, Mg/P_2O_5 and S/P_2O_5 ratios in the stem were lowered. When milli-equivalents of N, P_2O_5 and K_2O were expressed as percentages of composite N-P-K unit it was found that due to nitrogen deficiency the proportion of K_2O increased by 29% in the leaf and by 42% in the stem and that of P_2O_5 increased by 84% in the leaf and by 220% in the stem. "Deficiency symptoms of nitrogen thus appeared to be interrelated with sufficiency effects of phosphorus and potassium in the leaf and stem." It is suggested that effects of nitrogen on various physiological processes must be analysed in terms of concentrations and ratios in which different nutrients are present at centres of high metabolic activity.

1 Lal, K. N. (1951), Proc. Nat. Inst. Sci., India, **17**, 87.

2 Lal, K. N. and De, R. (1951), Nature, **167** 731.

Lal, De and Rao [3] determined the respiration rates, at the age of 250 days, of successive leaves on the main shoots of sugarcane varieties Co 453, Co 421, POJ 2878, Co 205 and Rheora, grown under normal and deficient levels of nitrogen, potassium and phosphorus in sand culture. Respiration rates of Co 205 and Rheora were significantly higher than those of Co 453 and POJ 2878. Nitrogen deficiency did not influence the rate of respiration whereas the latter was increased under phosphorus and potassium deficiency.

Datta and Guha [4] studied the influence of two forms of nitrogen (ammonium sulphate and sodium nitrate), in combination with three levels of potassium, on the growth of rice (var. Bhasamanik) in sand culture. Two months after germination plants under nitrate nitrogen were more or less dead due to acute chlorosis. The plants under ammonium nitrogen showed uneven growth and a large proportion of plants died under the highest level of potassium supply. It is suggested that low pH, 6.8 to 6.9, was responsible for the death of plants under nitrate nitrogen. It may be noted that although the authors refer to the earlier work of Asana [5] in this connection they do not discuss it in relation to their observations.

Dastur [6] has given an account of his observations on bad opening of bolls of cotton in the Anglo-Egyptian Sudan, which are of particular interest to India because of an apparently similar disorder, '*tirak*' so common in the Punjab and Sind. That Dastur was specially invited by the authorities there to advise on the matter is a fact worth recording as a fitting tribute to his important work on 'tirak' of cotton in the Punjab and Sind. The average yield of seed cotton in the Sudan approximates to about fifteen maunds of seed cotton per acre, which is more than double the average yield in India and Pakistan. Egyptian cottons (*Gossypium barbadense*) are grown in the Sudan, whereas Punjab-

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3 Lal, K. N., De R. and Rao, M. S. S. (1951). Proc. Indian Acad. Sci. **33 (B), 1.**

4 Datta, C. and Guha, B.P. **(1951),** Science and Culture, **16**. 323.

5 **Asana,** R. D. (1945). Indian. J. Agr. Sci., **15**, 227.

6 Dastur, R. H. (1951). Emp. Cott. Grow. **Rev., 28**, 183.

American cottons (*G. hirsutum*) are grown in the Punjab. Due to '*tirak*' in the Punjab the seeds as well as lint were immature, while due to 'bad opening' in the Sudan lint alone was found to be immature, the seeds being usually hard and sound. During an actue incidence of '*tirak*' in the Punjab the yield of seed cotton decreased by nearly 50% but the yield in the Sudan was of an average level even when bad opening occurred on an extensive scale in the 1948-49 season. The number of seeds per boll in the badly opened bolls in the Sudan was reduced but the setting percentage of flowers appeared to be above normal. In the Punjab bolls cracked prematurely with immature seeds and weak lint, whereas in the Sudan lint quality alone deteriorated. Based on these and other interesting observations Dastur has made some useful suggestions about the lines along which the problem can profitably be investigated.

In an attempt to find the cause of cracking of potato tubers Guha [7] analysed the irrigation water and found its lime content to be high; from this he inferred that cracking was due to boron deficiency induced by high lime content.

Mitra and Datta [8,9] report that ascorbic acid had a marked effect on the growth of excised embryos of jute and that its effect was much more pronounced in the culture containing ammoniacal nitrogen as compared to that with nitrate nitrogen. Abnormal development of cotyledons was also noticed in the ammonium sulphate culture. Chlorophyll in the cotyledons appeared earlier in the potassium nitrate culture. It was observed, in contrast with the findings of Virthanen and von Hausen, that ascorbic acid was effective in promoting healthy growth of roots.

Lal and Yadav [10] compared the effects of farmyard manure and castor cake upon the yield and seed quality of wheat and found the latter to be more beneficial.

In a review article, Lal and Rao [11] have assessed the rôle of

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7 Guha, M. P. (1951), Science & Culture, **17**, 40.

8 Mitra, J. and Datta, C. (1951) *Ibid*, **16**, 421.

9 *Idem* (1951), *Ibid*, **16**, 531.

10 Lal, K. N. and Yadav, B.S., (1951). Proc. Ind. Acad. Sci., **33 B**, 69.

11 Lal, K. N. and Rao, M.S.S. (1951), Science & Culture, **16**, 553.

manganese in crop production.

Sankarasubramony, Pandalai and Menon [12] determined the manganese content of leaves of coconut and of the soil with a view to seeing if there were any relation between manganese nutrition and an obscure disease affecting the coconut palm. No consistent differences in the manganese contents of healthy and diseased plants and of the soils of respective areas were found.

Developmental physiology

Sircar and Sen [13] investigated the effect of a short photoperiod (8 hours) of six weeks' duration, under September and February sowings, respectively, on the time of ear emergence in winter-paddy, *Rupsail*. Plants sown in September and February and maintained under the normal day length flowered after 137 and 250 days respectively, while with a short day pre-treatment the time of ear emergence in September sown plants ranged from 67 to 189 days and that of February sown from 62 to 76 days. After September sowing the temperature gradually decreased (upper limit for maximum 92.9°F and for minimum 81.6°F), whereas the reverse was the case in the other sowing (lower limit for maximum 90.8°F and for minimum 66.8°F). There was little grain-setting in the ears of the main shoot or tillers of both control and treated plants which emerged during a temperature range 83 to 61°F whereas normal grain setting appeared to take place under a maximum temperature of about 90°F. The authors conclude that winter (*aman*) varieties must be exposed to a critical day length before ears can emerge and the variations in the time of ear emergence observed under different sowings were due to variations in temperature associated with the latter.

Misra [14] found that under a short day (10 hours) and under normal temperature conditions ear emergence in 4 early varieties of paddy was delayed. In 2 varieties ear emergence in the main

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12 Sankarasubramony, H., Pandalai, K. M. and Menon, K.P.V. (1951). Indian Cocoanut Journal, **4**, 165

13 Sircar, S.M. and Sen, S.P. (1951), Current Science, **20**, 238.

14 Misra, G. (1951), *Ibid.*, **20**, 209.

shoot was suppressed in a certain proportion of plants which, according to the author, was due to heterozygosity.

Panigrahi [15] concludes that *Amaranthus gangeticus* var. *oleraceus Roxb.* is a distinctly short-day species, a 12-hour photoperiod keeping it vegetative. Best vegetative growth was obtained under a photoperiod of 18 hours and under continuous light leaves had a shrivelled appearance.

Chakravarti [16] found that branches growing out from the cotyledonary node and from a few nodes above, after decapitation, flowered earlier in the vernalized plants of mustard as compared to the controls.

Singh [17] studied the effect of vernalization and long day, on two varieties of wheat, *viz.*, C 13 and Punjab C 591. Vernalization hastened ear emergence in both the varieties, its effect being more pronounced on the relatively late-maturing variety C 591. The effect of vernalization was significantly reduced with increase in the photoperiod and its effect was completely masked under continuous illumination in C 13.

Chinoy and Nanda [18,19,20] studied the effects of photo-inductive and post-photoinductive treatments on the growth and development of three varieties of wheat, N.P. 165, N.P. 52, and Punjab C 591. The germinating seeds (in petrie dishes) were exposed to 6 hours of light and 18 hours of darkness, equal periods of light and darkness, 18 hours of light and 6 hours of darkness, continuous light and continuous darkness, respectively, for the first 18 days. The post-photoinductive treatments, namely 6 hours light, normal day and 18-hours day, respectively were started immediately after transplantation of seedlings to pots.

The vegetative period (from sowing to anthesis) was markedly shortened by increasing photoperiod, the effect being seen even in the case of photo-inductive treatments which were given for a few

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15 Panigrahi, G. (1951), Current Science, **20**, 19.
16 Chakravarti, S. C. (1951), Science & Culture, **17**. 35.
17 Singh, I. S. (1951), Current Science, **20**, 271.
18 Chinoy, J. J. & Nanda, K. K. (1951), Physiological Plantarum, **4**, 209
19 *Idem* *Ibid.*, **4**, 427.
20 *Idem* *Ibid.*, **4**, 575.

days only. The interaction between treatments and varieties was also found to be significant.

The rate of stem elongation was also accelerated by a long photoperiod in the initial stages with the result that the final height was attained earlier. Under normal as well as short days the stem elongated more slowly but the period of elongation was more prolonged. In view of the positive correlation between the vegetative period and the duration of stem elongation it is inferred that effect of the photoperiod on stem elongation was exerted through its primary effect on flowering. The earlier photo-inductive treatments had on the whole a smaller effect on stem elongation. Photo-inductive and varietal effects on tillering were also of a smaller order.

Dry weights of different plant parts of variety N. P. 52 under different treatments were also determined. The relative growth rate and the net assimilation rate were not influenced by different photoinductive treatments. Under normal as well as long day these were appreciably accelerated. When the net assimilation rate was corrected for the hours of illumination the effect of daylength disappeared, thus indicating that the decrease in dry matter as well as tillering was due to reduction in the duration of photosynthesis. Under long days the water content decreased more rapidly and the stem leaf ratio increased earlier.

Dastur [21] concluded from his studies on the growth and development of Sea-Island cotton in the Punjab and Sind that it did not perform well in these tracts due to the generally higher temperature level than that of Egypt where this cotton thrives so well. This led Doraswami and Iyengar [22] to attempt to grow Sea Island cotton in Mysore where the temperature prevalent during the life-cycle of the crop differs only slightly from that of Egypt and the Sudan. In view of the higher monsoon rainfall in Mysore which seemed to check the development of the bolls, the effect of twelve sowing dates, spaced one month apart, was investigated and it was concluded that October to November sowing gave the highest yield. Plants under this sowing were vigorous and healthy due to

21 Dastur, R. H. (1949). Indian Cott. Grow. Rev., **3**. 121.

22 Doraswami, L. C. and Iyengar, G. S. (1951). *Ibid*, **5**, 1.

dry weather prevailing after the south-west monsoon. By the time the relative humidity increased from February onwards flowering was nearly complete and pickings commenced in April. According to the authors, possibilities of growing in Mysore superior cottons like the Egyptian and the Sea Island are great but the causes of low yields remain to be investigated. The reviewer may point out that differences in day length, if any, may perhaps account for the low yields.

Growth regulators

Sircar and Das [23] found that as compared to the auxin content of the dormant endosperm of rice grains (as determined by the Avena test), that of grains germinated at 26° and 10°C was reduced by 88 and 54% respectively, the period of germination being 5 days. The size of the root and the shoot was considerably greater under the higher temperature and thus the higher growth rate of the embryo at this temperature is regarded as the cause of the greater reduction of the auxin content.

Shri Ranjan and Kaur [24] made extracts of wheat spike at four stages of its growth namely, when enclosed within leaf sheath, before anthesis, at anthesis and after anthesis, and injected these into cut leaves (by immersion and suction technique) of the plants at the corresponding above-mentioned stages. It was found that the respiration rate of the leaves was stimulated by extracts obtained at the last two stages. Shri Ranjan and Kaur [25] sprayed flowers of *Hibiscus esculentum* and *Solanum melongena*, at different stages, with indolebutyric acid, methylnaphthoxyacetate and chlorophenoxy-acetic acid. Spraying at pre-anthesis stage led to shedding of young fruits or reduction in size and seedlessness of fruits of *Hibiscus esculentum*. Spraying at anthesis did not influence the size of the fruit but spraying after anthesis increased fruit size. In *Solanum melongena* spraying before anthesis resulted in seedless fruits with a modified shape.

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23 Sircar, S. M. and Das, T. M. (1951), Nature, **168**, 382.

24 Shri Ranjan and Kaur, R. (1951), Proc. Ind. Acad. Sci., **33**, 321.

25 *Idem* (1951), Current Science, **20**, 69.

Singh [26] describes a modified method of air-layering of Litchi which consists in selecting vigorous terminal branches, preferably with a fork near the top, removing the bark, applying 'rootone' and covering the ring with damp sphagnum moss and then with an air-wrap (a special plastic material which allows exchange of respiratory gases but no loss of moisture) fixed in position by a rubber band. About 2 months later the layers are ready for potting. This method saves the trouble of frequent watering. Singh [27] also found a greater survival of air layers of *Atrocarpus integrifolia* as a result of the use of naphthaleneacetic acid.

Singh and Teotia [28] studied the effect of indoleacetic acid, indolebutyric acid, phenylacetic acid and naphthaleneacetic acid on rooting in mango. One per cent naphthaleneacetic acid induced rooting in all the cuttings of the variety 'Dasheri' as compared to none under untreated controls. Two per cent indoleacetic acid gave the best result in the variety 'Langra'. The roots survived only in association with double layering or gootee cum pot layering before severing from the mother plant.

Rao, Wariar and Moses [29] were able to control nut grass (*Cyperus rotundus*) by two to three sprayings of 0.2% Fernoxone (sodium salt of 2, 4-D). The substance appeared to be more effective in dry land. In dry land one spraying on a month old Sorghum crop suppressed the growth of the weed and gave 83% increase in grain yield.

In a semi-popular article Asana [30] has discussed the weed problem under Indian conditions and the possibilities of the use of hormonal weedicides.

Water relations

Mallik [31] determined the relative transpiration rates of a variety of sugarcane, Co 421, and *Saccharum spontaneum* under dry and humid conditions and found that the former showed a

26 Singh, L. B. (1951), *Ibid.*, **20**, 102.

27 *Idem* (1951), *Ibid.*, **20**, 102.

28 Singh, S. N. and Teotia, S. S. (1951), Science and Culture, **17**, 207.

29 Rao, P.K., Wariar, U.A. and Moses, L. (1951). Madras Agri. J. **38**, 283.

30 Asana, R. D. (1951), Indian Farming, 1 (N. S.) 13.

31 Mallik, A. K. (1950), Indian J. Agri. Sci. **20**, 143.

much lower rate of relative transpiration. The values of relative transpiration did not differ for *Saccharum spontaneum* under dry and humid air, whereas that of Co 421 was much lower under dry air. It is concluded that Co 421 is more drought-resistant than *Saccharum spontaneum*. It may, however, be noted that according to Maximov plants adapted to arid conditions very often have as high a transpiration rate as mesophytes and that transpiration rate is not an unfailing index of drought resistance.

Narasinga Rao [32] points out that rice needs more water than any other agricultural crop, that more water is needed by a variety of longer duration and that the amount required also depends upon soil type. The need for more scientific work in this connection is emphasized.

Miscellaneous

Roberts and Wood [33] have investigated the changes in the amino-acids and amides in withering of tea leaves (the first process in the manufacture of tea) by means of paper chromatography. There was a general increase in all amino-acids and amides as a result of withering. The chromatograph showed several unidentified spots which apparently do not correspond with any of the known amino-acids. Both in the fresh and withered leaf aspartic and glutamic acids were the most abundant of the amino-acids occurring.

Lal and Subbarao [34] have described a rapid method of determining leaf area on growing plants of graminaceous type.

Choudhri and Bhatnagar [35] found that rooting in leaf cuttings of tomato was not confined to callus region of the petiole or petiolules but also occurred at a considerable distance from the callus region under favourable conditions.

Krishna Iyengar [36] found that the topmost two setts of sugaracane were on the whole the best for early October planting.

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32 Narasinga Rao, (1951), Madras Agri. J., **38**, 539.

33 Roberts, E. A. H. and Wood, D. J. (1951), Current Sceince, **20**, 151

34 Lal, K. N. and Subbarao, M. S. (1951), Nature, **167**, 72.

35 Choudhri, R. S. and Bhatnagar, V. B. (1951), Proc. Indian Acad. Sci., **34**(B), 43.

36 Krishna Iyengar, (1951), Nature **168**, 252.

The next best were the third and the fourth whereas the still lower internodes gave very inferior plants. The same order did not however, hold good for planting during the other months.

Venkataratnam[37] used 2, 3, 5-triphenyl tetrazolium-chloride in seed viability test and found a significant correlation between germination and the number of stained embryos in the case of millets and paddy. In some dicots like cowpea, Bengal gram, *Phaseolus trilobus*, *Phaseolus radiatus*, *Cajanus cajan*, *Arachis hypogea*, *Tephrosia purpurea ans Sesbania aculeata* the number of stained seeds did not correspond with actual seed germination and the author thinks that this test is unsuitable for critical assessment of seed viability in these plants.

Mukherji[38] found that shrivelled grains of red maize showed low germination capacity and the seedlings showed poor vigour and flowered late. Culturing of embryos from shrivelled seeds did not improve the vigour of the plants.

Datta[39] has reviewed the present position of our knowledge on plant pigments.

37 Venkataratnam, L. (1951) Madras Agri. J., **38**. 248.

38 Mukherji, D. K. (1951), Proc. Nat. Inst. Sci, India. **17**. 253.

39 Datta, C. (1951), Science and Culture. **16**. 458 & 512.

ENZYMES

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During the period under review, interest in the field continued unabated. Among the many contributions on enzymes, mention may be made of those relating to the study of the nature of lipases from oil seeds and moulds, phosphatases of cocoanut, pyrophosphatases of potato and moulds, choline esterase from cobra venom and the detection and separation of enzymes by paper chromatography. Investigations on phosphatase and tributyrinase in milk and on enzymes at different stages of ripening of cheese have been reviewed in the section on "Dairy Science."

Esterases

Ramakrishnan and Nevgi [1-13] have made an exhaustive study of the nature of the lipase from oil-seeds with particular reference to its occurrence and behaviour under varied conditions of both the hydrolysis and synthesis of esters and fats. A comparative study of the lipases from different oil-seeds (castor, sesame and safflower) showed that the ricinus lipase possessed the greatest activity while the activity of the lipase from safflower seeds was the least. The ricinus lipase obtained as a powder by extracting castor seeds

1 Nevgi, G. V. and Ramakrishnan, C.V. (1950), J. Ind. Chem. Soc., **27**, 255.
2 *Idem* ,, *Ibid.* **27**, 260.
3 Ramakrishnan, C. V. and Nevgi, G. V. ,, ,, **27**, 263.
4 *Idem* ,, ,, **27**, 264.
5 *Idem* ,, ,, **27**, 265.
6 *Idem* ,, ,, **27**, 331.
7 *Idem* ,, ,, **27**, 333.
8 *Idem* ,, ,, **27**, 334.
9 *Idem* ,, ,, **27**, 337.
10 *Idem* (1951) ,, **28**, 271.
11 *Idem* ,, ,, **28**, 272.
12 *Idem* ,, ,, **28**, 333.
13 *Idem* ,, ,, **28**, 335.

with petroleum ether and drying with acetone was found to keep its activity constant for a fairly long time. The ricinus lipase had an optimum pH of 4.9 for the hydrolysis of olive oil in sodium acetate-acetic acid buffer. The synthetic activity of the ricinus lipase was found to depend on several factors.

The maximum percentage synthesis of a simple aliphatic ester from alcohols and carboxylic acids was independent of the number of c-atoms of the acids but dependent on the number of c-atoms of the alcohol, as also on the nature and number of the hydroxyl groups of the alcohol. In general it was found that the percentage synthesis increased from methyl to amyl ester and was greater for the iso ester than for the normal ester. Further the percentage synthesis of an ester increased with an increase in the number of the OH groups of the alcohol used. The tertiary esters were most readily synthesised while the normal esters were synthesised least readily. Increasing the molecular concentration of the alcohol or acid used increased the percentage synthesis of the ester and the maximum increase was attained by using 2.592 g. mol. of alcohol or acid. The synthesis of esters by the ricinus lipase was accelerated by the use of $CaCl_2$, $BaCl_2$ or $MnSo_4$ as catalysts whereas $AlCl_3$ and $K_2 Cr_2 O_7$ act as poisons. Generalizations similar to those on the lipolytic activity of the ricinus lipase in the synthesis of esters from their components hold good for the reverse reaction viz., the hydrolysis of esters.

Ramakrishnan and Banerjee [14] have investigated the effect of some water-soluble vitamins on the activity of the ricinus lipase and found that the addition of thiamine, riboflavin or ascorbic acid, while not changing the optimum pH, increased the activity of the ricinus lipase. The increase was greater when ascorbic acid was added and least when thiamine was added. The authors also made a comparative study of the lipases from oil seed cakes [15] and found that the groundnut and castor cake lipases showed the greatest activity and that groundnut oil was the best substrate. The activity of the lipase from the oil seed cake was, however, lower than that from the corresponding seed.

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14 Ramakrishnan, C. V. and Banerjee, B. N. (1951), *Ibid.*, **28**, 471.

15 *Idem* (1951), *Ibid.*, **27**, 655.

In a series of papers Ramakrishnan and Nevgi [16] and Ramakrishnan and Banerjee [17-23] have presented a large amount of data on lipases obtained from molds grown on oil seeds. Molds like *A-flavis*, *A-niger* or *A-oryzae* grown on cocoanuts or cotton seeds were shown to possess lipolytic activity. The activity of the lipase of *A-niger* isolated from castor seed was very high and the mould had a good growth in 4 days at 35°C in groundnut cake medium containing 15% oil free groundnut cake, 10% groundnut oil and 200 c.c. water adjusted to pH 4.2. This mould lipase had an optimum pH of 6.2 in disodium phosphate-citric acid buffer. It was also found that the addition of sodium sulphate or ammonium chloride or potassium nitrate to the groundnut cake medium enhanced the growth as well as the lipolytic activity of *A-niger*. Likewise, addition of 10% xylose, glucose or galactose or 15% glycerine or triolein had similar effect on the growth and activity of *A-niger*. A general study of the lipase extracted from the moulds grown on oil seeds showed that groundnut oil was the best substitute and that disodium phosphate-citric acid was the best buffer for the mould lipase, whose optimum temperature was 37°C. The activity of the mould lipase was higher than that of the oil seed or oil seed cake lipases.

Sadasivan [24] has investigated the distribution of enzymes in the various parts of cocoanut and the properties of the phosphatases in the kernel. The phosphatases (phospho, mono and di-esterases, pyrophosphatase and phytase) had an optimum pH of about 5.6 and their activity was inhibited by fluoride ions. They were not activated by Mg^{++} or Mn^{++}

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16 Ramakrishnan, C. V. and Nevgi, G. V. (1950) Ann. Biochem. Expt. Med., **10**. 19.

17 Ramakrishnan, C. V. and Banerjee, B. N. (1951) Experientia, **7**, 434.

18 *Idem* (1951) Research, **46**, 434

19 *Idem* (1951) *Ibid.*, **4**, 389.

20 *Idem* (1951) Science, **113**, 125.

21 *Idem* (1951) Nature **168**, 917.

22 *Idem* (1951) Enzymologia, **15**, 33.

23 *Idem* (1951) *Ibid.*, **15**, 98.

24 Sadasivan, V. (1950) Arch. Biochem. **30**, 159.

Krishnan [25] has reported the existence of two different pyrophosphatases in moulds. One of them (with an optimum pH between 3 and 4) was inhibited by Mg^{++} while the other (with an optimum pH of about 7) was activated by $Mg.^{++}$

Continuing his studies on choline-esterase from cobra venom Chowdhuri [26] showed that the enzyme was activated by cysteine and H_2S but inactivated to a certain extent by reagents like I_2 ICH_2COOH and NaF. The maximum accelerating effect is 20% of the original.

In a subsequent paper Chowdhuri [27] has presented the results of his investigation on the reversible inactivation of choline esterase. He showed that the partial inhibition caused by mild oxidising agents (I_2, H_2O_2, $AgNO_3$) was restored by cysteine H_2S, Vitamin C or NaCN. It was assumed that owing to the presence of a disulphide configuration, a part of the enzyme existed in the inactive form and that the conversion of disulphide linkage to that of the sulphydryl by reducing agents, increased the activity.

Naganna [28] has reported the existence of alkaline pyrophosphatase in potato and described its properties. The pyrophosphatase was inactive in the absence of Mg^{++}. The optimum pH of the enzyme ranged from 8.55 to 9.64 in the presence of 0.01—0.1m Mg^{++}. The enzyme was labile and was inactivated in acid pH. Ca^{++}, Cu^{++}, F^{-} Zn^{++} and HCHO used in low concentrations produced marked inhibition. Since the inhibition by Cu^{++} could be reversed by cysteine, SH groups would be essential for the enzyme to be active. HCHO inhibition suggested that amino group would also be essential for the activity of the enzyme. It was concluded that the pyrophosphatase was similar to erythrocyte and other animal tissue alkaline pyrophosphatases.

Amylase

Roy [29] has crstallised the alpha-amylase from culture filtrates of *Aspergillus oryzae*. After concentration and separation from other

25 Krishnan, P. S. (1951) *Ibid.*, **32** 130.

26 Chowdhuri, D. K. (1950) Ann. Biochem. Expt. Med., **10**, 65.

27 Chowdhuri, D. K. (1950) Ibid., **10**, 71.

28 Naganna, B. (1951) Current Science, **20**, 101.

29 Roy, D. K. (1950) Science & Culture, **16**, 77.

enzymes, the alpha-amylase from cultures of *Aspergillus oryzae* was crystallised from 0.5 saturated (ammonium sulphate). The crystals were hexagonal and possessed an activity of 1 : 20000.

Apyrase

Krishnan [30] has studied the apyrase activity of the mycelial mats of *Aspergillus niger* and *Pencillium chrysogenum*. The enzymic activity was found to be high during metabolism, decreasing however during autolysis. The apyrase activity and the optimum pH varied with the strain used. A highly active preparation was obtained by fractional precipitation with ammonium sulphate. The preparation was free from glucose oxidase but showed considerable pyroyhosphatase activity. The apyrase was inhibited by Ca^{++} and Mg^{++}.

Other Enzymes

Basu and Nandi [31] have described a method for determining the extent of inactivation of pepsin, by a simple iodometric estimation of the cysteine groups liberated during the inactivation of pepsin. The method would be applicable even if the pepsin were to breakdown following inactivation.

Mukherjee [32] has made some preliminary investigations on enzymic systems involved in the spoilage of fats. The presence of several enzyme systems has complicated the mechanism of onset of rancidity of fats by micro-organisms by causing various reactions to take place, simultaneously. The glycerides are broken up by lipases into free fatty acids and glycerol. The individual components are then rapidly oxidised by fatty acid oxidases, lipoxidases and dehydrogenases. Further oxidation is caused by oxidative enzymes and it is followed by secondary decompositions of the peroxidases.

Nanda [33] has shown the existence of a parallelism between catalase ratio (ratio of the catalase activity of the soaked seeds to that of the dry seeds) and germinating capacity of seeds.

30 Krishnan, P. S. (1951) **Nature, 168,** 171.

31 Basu, S. and Nandi, S. P. (1951), Enzymologis, **14**, 398.

32 Mukherjee, S. (1951) Biochem. et Bio. Physic., **33,** 364.

33 Nanda, K. K. (1950) Current Science, **19,** 22.

Reddy[34] has studied the influence of thiaminase in fresh water mussel on the availability of added thiamine to rats. It was found that the 'anti-thiamine factor' present in the fresh water mussel was capable of destroying vitamin B_1, both *in vitro* and *in vivo*. This would prove of value for the biological assay of vitamin B_1 as also for the preparation of diets free from vitamin B_1.

Chromatography of Enzymes

Giri and Prasad[35, 36] have developed a technique for the detection and separation of enzymes by paper chromatography. The method for the location of the position occupied by an enzyme on the paper chromatogram consisted in placing the paper on an agarplate containing a suitable substrate, allowing sufficient time for the enzyme to act on the substrate and finally revealing the active zones by flooding the agar-surface, after the removal of the paper, by an appropriate reagent, when coloured or colourless spots were obtained on a colourless or coloured background. For amylases the agar was impregnated with starch and the position of the enzymes was revealed by flooding the agar surface with N/100 I_2 when colourless spots were formed on a blue background. For phosphorylases the substrate used was Cori-ester and consequently the active zones were blue in colour while the background was colourless. The detection of phosphatases could be done using sodium phenolphthalin phosphate as the substrate and N/10 alkali as flooding reagents when pink spots would be obtained on a colourless background. The Rf values of amylases from *Aspergillus niger* and sweet potato, using aqueous acetone and alcohol were obtained. By using a 1% sodium chloride solution the amylase and proteinase of commercial trypsin were successfully separated.

34 Reddy, K. K. (1950) Proc. Nat. Inst. Sci. India, **16**, 221.

35 Giri, K. V. and Prasad, A. L. N. (1951) Nature, **167**, 859.

36 Giri, K. V. and Prasad, A. L. N. (1951) Nature, **168**.

CHEMISTRY OF PLANT PRODUCTS

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Year after year, increasing interest is being evinced in the investigation of natural products. The establishment of the Central Drug Research Institute at Lucknow,[1] formally declared open by the Prime Minister, Shri Jawaharlal Nehru, on 17th February 1951, forming the seventh of the chain of national laboratories and comprising the divisions of (1) Chemistry, (2) Bio-Chemistry, (3) Pharmacology, (4) Microbiology and Parasitology, and (5) Clinical Science, should serve as additional fillip to pursue this field of research so necessary and suitable to our country. During the year 1951, the publications by Indian workers dealing with the chemistry of plant products numbered about seventy. For the purpose of this review, the work contained in these publications has been classified under the headings (1) oils and fats, (2) essential oils, (3) alkaloids, (4) colouring matters, (5) bitter principles and (6) other plant products.

Oils and fats

The seeds of *Emblica officinalis*, Gaertm., have yielded about 26 per cent of a fixed oil containing 87 per cent of mixed acids, small quantities of sitosterol and a crystalline substance, m.p. 124-125°C giving the test for phytosterol. The component fatty acids in the oil are: linolenic, 8.78; linoleic, 44.00; oleic, 28.40; stearic, 2.15; palmitic, 2.99 and myristic, 0.95 per cent.[2]

The fatty acid composition of the seed oil from the jute plant *Corchorus olitorius*, as determined by fractionation of the methyl esters of the mixed acids is: palmitic, 15.65; stearic, 4.00; behenic, 1.66; lignoceric, 1.12; oleic, 12.43; linoleic, 59.67; and C_{20} (mono-ethenoid) acid, 2.42 per cent. The oil contains 3.05 per

1 Editorial (1951), J. Sci. Ind. Research, India, V, 10A, 139.

2 Dhar, D. C., Dhar, M. L., and Shrivastava, D. L. (1951), *Ibid*, V, 10B, 88.

cent unsaponifiables.[3] Two new sterols, m.p. 128-129°C and 116°C have been isolated from the non-saponifiable portion (3 per cent) of jute *Corchorus capsularis* seed oil.[4]

Analysis of the seed meal and the seed oil from ***Annona squamosa*** and ***Annona reticulata*** have yielded the following results.[5]

Analysis of seed meal

		A. squamosa	*A. reticulata*	
Moisture	...	6.1	8.2	
Oil	...	39.5	42.0	
Protein	...	19.2	14.0	
Crude fibre	...	14.1	14.1	
Ash	...	4.0	4.2	
Carbohydrates	...	17.1	17.5	

Analysis of seed oil

		A. squamosa	*A. reticulata*	
Iodine value	...	83.3	87.6	
Myristic acid	...	0.3	0.5	per cent
Palmitic acid	...	12.5	16.6	,,
Stearic acid	...	8.9	6.7	,,
Arachidic acid	...	1.8	nil	,,
Hexadecenoic acid	...	2.3	4.3	,,
Oleic acid	...	54.2	49.6	,,
Linoleic acid	...	20.0	22.3	,,

The semi-solid product obtained by alcoholic extraction of the fruits of *Terminalia balerica*, Roxb. has been separated into petrol soluble and petrol insoluble fractions. The former has yielded a green fixed oil having the following constants : acid value, 21.89 ; saponification value, 185.85 ; iodine value, 75.82 ; percentage of mixed acids, 54.25 ; iodine value of mixed acids, 71.5. The petrol insoluble fraction has yielded a saponin, tannin, and a yellow product all of which require further characterization.[6]

3 Chakravarti, J.K. and Sen, N.K (1951), J. Indian Chem. Soc. **28**, 390.

4 *Idem.*, (1951) *Ibid.*, **28**, 727.

5 Naidu, B. and Achaya, K.T. (1951), J. Indian Chem. Soc., Ind. Edn., p 14.

6 Sen, S. P. and Tayal, J. N. (1951), J. Amer. Pharm. Assn., Sci. Edn., **40**, 475.

The oil from the seeds of *Pongamia glabra* obtained in 28.29 and 34.4 per cent yield by expression in the cold and by hot pressing respectively, has the following characteristics: specific gravity at 30°C, 0.9273; refractive index at 30°C, 1.4736; saponification value, 181.5; iodine value, 89.1; acid value, 6.3; unsaponifiables, 42 per cent; acetyl value, 20.9 per cent and rosin acids, 1.2 per cent. Methods for refining the oil by the use of acid and alkali have been described.[7]

The pale yellow semi-drying oil obtained in 8.4 per cent yield from the seeds of *Ipomoea muricata* comprises the acids: oleic 58.85; linoleic, 18.61; linolenic, 1.13; palmitic, 7.83 and stearic, 11.23 per cent. The unsaponifiable matter (1.09 per cent) consists of a mixture of three sterols.[8]

Since 96 per cent of the mixed acids of the seed fat of *Actinodaphne hookeri* (Pisa fat) is lauric acid, this fat has been recommended as a substitute for cocoanut oil for making soaps.[9,10] The yields of fat by hot expression in a hydraulic press at 50°/5,000 lbs. and by solvent extraction with petrol (b. p. 60-80°C) are 32 and 48 per cent respectively.[10]

In an article entitled "Resins from fixed oils," the vast scope for the manufacture of resin like bodies from indigenous oils has been pointed out.[11]

An oxy acid, $C_{18}H_{30}O_3$ m. p. 77-78°C, isomeric with the one (m.p. 86-87°C) previously reported [12] has been isolated from the seed oil of *Mallotus phillippinensis*, Muel Arg. (Kamla) and characterized.[13]

Methods for the preparation of modified oils from tobacco seed and safflower seed oils have been described. Varnishes and ready mixed paints containing these modified oils are superior to those

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7 Vidyarthi, N. L. (1951), Indian Soap, J., **17**, 54.

8 Misra, A. L. and Tewari, J. D. (1951), J. Indian Chem. Soc., **28**, 721.

9 Gupta, S. C., Phadnis, J. S. and Agarwal, J.S. (1951), Soap, **4**, 11.

10 Kane, J. G. (1951) Indian Soap, J., **17**, 72.

11 Pillai, D. K. P. and Janardhan, (1951), *Ibid.*, **17**, 52.

12 Agarwal *et al*, (1948), J. Sci. Ind. Research, India, **7B**, 136.

13 Gupta, S. C., Sharma, V. N. and Agarwal, J. S. (1951), *Ibid.*, **V**, **10B**, 76.

formulated with linseed oils.[14] The drying properties of niger seed and safflower seed oils have been studied [15] and it has been shown that acetylation of the oils markedly reduces the time of drying.[16]

Castor oil gel, heated at 185-95°C in an autoclave is converted into a liquid product which can be used in the preparation of baking enamels, varnishes and lacquers. The saponifiable part of the liquid product consists mostly of dilinoleic acid.[17]

A procedure employing potassium chlorate and hydrochloric acid has been found satisfactory to refine the oil obtained in 68 per cent, yield from Nageshwar or Nachar (Mesua ferrea) seeds.[18] Application of the centrifugal technique for refining oils has been recommended so that oil loss may be minimised.[19]

A method involving the determination of the refractive index after acetylation has been developed for the evaluation of castor oil in oil mixtures.[20]

Causation of rancidity in Mahwa (*Bassia latifolia*) oil soaps has been attributed to the presence of highly unsaturated, easily oxidisable hydrocarbons and pigments in the unsaponifiable portion of the oil.[21] Mukherji [22] has studied the mechanism of autoxidation in oils and fats. Kane and Randive [23] have determined the aniline point of some fats.

Essential oils

The essential oil obtained in 0.4 to 0.6 per cent yield from the dry leaves of *Atlanta monophylla* (D.C. Prodr Flourbinda-

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14 Sharma, P. G., Budhraja, N. C., and Agarwal, J. S. (1951), *Ibid* **V, 10B**, 33.

15 Vidyarthi, N. L. (1951), *Ibid.*, **V, 10B**, 170.

16 *Idem*, (1951), *Ibid.*, **V, 10**B, 233.

17 Gupta, A. S. and Agarwal, J. S. (1951), *Ibid.*, **V, 10**B, 73.

18 Gupta, A. C. (1951), *Ibid.*, **V, 10**B, 24.

19 Ramaswami, G. V. (1951), *Ibid.*, **V, 10A**, 292.

20 Achaya, K. T. and Saletore, S. A. (1951), *Ibid.*, **V, 10**B, 118.

21 Srivastava, P. V. and Rao, S. N. S. (1951), S. P. C. July, p 673, *cf.* Indian Soap, J., **17**, 81.

22 Mukherji, S. (1951), Indian Soap, J., **17**, 183.

23 Kane, J. G. and Randive, G. M. (1951), J. Sci., Indian Research, India, **V, 10B**, 62.

wight) and known as wild lime oil comprises: *l*-sabinene, 38; *l*-linalol, 14; *l*-linalylacetate, 17; and unidentified higher terpene esters, belonging to azulene group, 29 per cent.[24]

In addition to α *d*-phellandrene, cineol, citronellal and citral already reported,[25] two more components *viz.*, *p*-cymene, 17 per cent and cuminaldehyde, 5 per cent have been found in the essential oil from the leaves of (Bel), *Aegle marmelos*. While the oil from the twigs contains cineol, 40-45 per cent and α *d*-phelandrene, 34.5 per cent. the oil from the fruits contains α *d*-phellandrene only.[26]

Ocimum kilimandscharicum cultivated in Kanpur and Lucknow has yielded to laboratory scale and semi-large scale distillations 3.20 to 4.71 and 2.8 to 3.6 per cent respectively of a mixture of camphor and camphor oil, calculated on the weight of the dry leaves. The camphor content of the mixture varies from 52 to 60 per cent. It has been indicated that manufacture of camphor and camphor oil from ocimum leaves in India could be a profitable industry.[27]

Lemon grass oil distilled in Travancore, South India, from *Cymbapogan flexuosus* contains citral, geraniol, linalool, dipentene and limonene, small amounts of citronellal, traces of cymene, *n*-decylaldehyde, another aldehyde isomeric with citral and methylheptanone.[28]

During a study of the economics of cultivation of and the extraction of peppermint oil from *Mentha piperita* in Uttar Pradesh India, it has been shown that the oil produced in Kanpur contained the following constituents: *l*-limonene, 7.87; valeric acid, 6.12; menthone, 3.02; menthyl ester, 21.50 and menthol, 26.23 per cent.[29]

Verghese and Gulati [30] have published a short monograph on

24 Nayak, U. G. and Guha, P. C. (1951), J. Ind. Chem. Soc., **28**, 713

25 Baslas, K. K. and Deshapande, S. S. (1949), *Ibid*, **26**, 231.

26 Baslas, K. K. and Deshapande, S. S. (1951), *Ibid.*, **28**, 19.

27 Dhingra, D. N., Ganjoo, T. N. and Gupta, G. N. (1951), Indian Soap. J., **17**, 85.

28 Varier, N. S. (1951), *Ibid.*, **17**, 68.

29 Dhingra, D.R., Gupta, G.N. and Mehrotra, J.N. (1951), *Ibid*, **17**, 43.

30 Verghese, J. and Gulati, K.C. (1951), J. Sci. Ind. Res. India. V. **10A**, 112.

turpentine oil from *Pinus longifolia* Roxb. detailing its constituents, properties and uses.

A new crystalline lactone has been isolated from solvent extracted costus oil from the roots of *Saussurea lappa* (C. B. Clarke). This lactone has the composition $C_{15}H_{20}O_2$, m.p. 145-47°C, and on. hydrolysis yielded saussureic acid, $C_{15}H_{22}O_3$, m.p. 130-32°C. The new lactone may serve as fixative in high class perfumery.[31]

Alkaloids

In pointing out that chemical examination of plants might aid in determining the botanical classification in *Mahonia* genus, it has been shown that the subtle morphological differences of several species of *Mahonia* have been justified with reference to the difference in quantity and nature of their alkaloids. While the morphologically allied species, *M. acanthifolia*, *M. simonsii* and *M. borealis* contain the alkaloids oxyacanthine, berberine, neprotine, palmatine and jatrorrhizine in varying quantities, *M.nepalensis* contains umbellatine and neprotine and *M. philippinensis* contains berberine, shobakunine and jatrorrhizine.[32] The roots of *M. leschenaultii* (Wall) Takeda from South India contain oxyacanthine, in traces; berberine, 1.02; neprotine, 0.011; palmatine, 0.075 and jatrorrhizine, 0.031 per cent. The roots of *M. manipurensis* contain very small quantities of oxyacanthine, berberine, neprotine, and jatrorrhizine. The stem bark of *M. sikkimensis* has furnished oxyacanthine, in traces, berberine, 0.46 and neprotine, 0.001 per cent. It has been suggested that *M. manipurensis* Takeda should preferably be called a variety of *M. borealis*, Takeda, rather than a separate species, as both of them show great chemical, morphological and histological similarities.[33]

Neprotine, $C_{19}H_{23}O_6N$, has so far been found in eight Indian

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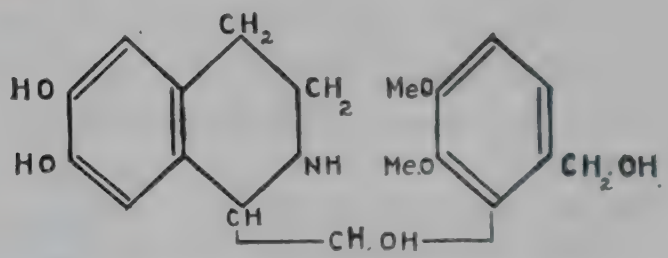
31 Rao, P.S. and Varma, B.S. (1951), *Ibid.*, V. **10**B, 166.

32 Chatterjee, R., Guha, M.P. and Sen, S.K (1951), J. Amer. Pharm. Ass. Sci. Edn., **40**, 36.

33 Chatterjee, R. and Guha, M.P. (1951). *Ibid.*, **40**, 229.

species of *Mahonia, viz., M. nepalensis, M. griffithii, M. acanthifolia, M. borealis, M. simonsii, M. leschenaultii, M. sikkimensis* and *M. manipurensis*. The roots of *M. borealis* and *M. simonsii* are the richest in this alkaloid, the percentage of yield being 0.31 and 0.27 respectively. Neprotine is a secondary base containing two methoxyl, two phenolic hydroxyl, and two alcoholic hydroxyl groups. It yields isoquinoline on zinc dust distillation, opianic acid on oxidation with manganese dioxide and sulphuric acid, and *ortho*-hemipinic acid on oxidation with potassium permanganate. Its absorption spectra are similar to those of berberine. Methylated neprotine, on oxidation with potassium permanganate, yields both *ortho*- and *meta*-hemipinic acids. From all these considerations neprotine has been assigned the following formula tentatively.[34]



A comparative study of *Atropa* alkaloids from three species, grown in Kashmir, viz., *A. belladonna* (English variety), *A. acoumi-nata* (Indian variety) and a hybrid, has shown that the leaves contain only traces of the physiologically inactive (volatile) alkaloids as compared with the roots which contain appreciable amount of volatile alkaloids.[35]

From the alcoholic and ethereal extracts of the leaves of *Sarcocoa pruniformis*, a crystalline alkaloid, $C_{22}H_{36}ON_2$, m.p., 236-38° C and a non-nitrogenous product, $C_{26}H_{44}O_2$, m.p., 251-52° have been isolated.[36]

On treatment with alkali, the methiodide, $C_{21}H_{26}O_3N_2$, CH_3I, of rauwolscine, the alkaloid from *Rauwolfia canescens*, yields a betaine, $C_{21}H_{26}O_3N_2$, which is an isomer of the parent

34 Chatterjee, R. and Guha, M.P. (1951), *Ibid.*, **40**, 233.

35 Kapoor, L.D., Handa, K.L. and Singh, K. (1951), Ind. J. Pharm., **13**, 249.

36 Chopra, I. C. and Handa, K. L. (1951), *Ibid.*, **13**, 129.

alkaloid and is named *iso*-rauwolscine. Stepwise degradation of this betaine by exhaustive methylation has yielded *iso*-phthalic acid, harman and indole derivatives.[37]

From the alcoholic extract of powdered root of *Berberis floribunda*, the following eight alkaloids have been isolated and characterized: oxyacanthine, palmatine, corydaline, jatrorrhizine and columbamine.[38]

The dried leaves of *Physochlaina praealta*, Miers, contain 1.02 per cent of total alkaloids, 80 per cent of which is hyocyamine. The roots contain 0.64 per cent alkaloids calculated as hyocyamine. This plant grows wild and in abundance in Ladak valley, Kashmir, and can be exploited for the commercial production of hyocyamine.[39,40]

Lobelia pyramidalis, Vahl., indigenous to India is a rich source of lobeline group of alkaloids and can be used as a substitute for *L. inflata*, the official source of the drug lobelia. The dried leaves and flowering tops of *L pyramidalis* contain 0.29 to 0.38 per cent labeline.[41]

The different methods for the extraction of nicotin from tobacco and tobacco waste have been discussed by Gedeon.[42]

Indian ipecacuana from Mungpoo contains about 2.3 per cent total alkaloids of which more than 45 per cent contain no phenolic group. A process for the economic production of emetine hydrochloride has been described.[43]

Colouring matters

Morelline, the orange yellow pigment from the seeds of *Garcinia morella* (Mysore gamboge tree), has been fractionated to give morellins T, M and L by chromatographic separation on a silica gel column. Morellin L exhibits low activity against

37 Chatterjee, A. (see Mookherjee) (1951), J. Ind. Chem. Soc., **28**, 29.

38 Chatterjee, R. (1951), *Ibid.*, **28**, 225.

39 Handa, K.L., Nazir. B.N., Chopra, I.C. and Jamwal, K.S. (1951), J. Sci. Ind. Res. India, V. **10**B, 182.

40 Handa, K.L. (1951), *Ibid., V.*, **10**B, 234.

41 Datta, A. and Datta, S.C. (1951), *Ibid., V.*, **10**B, 218.

42 Geden, J. (1951), *Ibid, V.*, **10**A, 153.

43 Saha, S. K. (1951), *Ibid, V.*, **10**B, 76.

Micrococcus pyogens while the other two morellins are highly bacteriostatic to the organism. The morellins possess low activity against organisms of the enteric group. Morellin T, however, is active against *Aerobacter aerogenes*.[44]

Nimbicetin, isolated from the *Nim* (*Melia azadirachta*) blossoms has been found to be identical with 3 : 5 : 7 : 4′-tetrahydroxy-flavone, kaemferol.[45]

Action of acetyl chloride at ice-cold temperature, on gossypol —a colouring matter present in the cotton plant—dissolved in pure anhydrous pyridine has led to the formation of only the white gossypol hexa-acetate, m. p. 278-79°C, instead of a mixture of the latter with the yellow "hexa-acetyl gossypol", m. p. 186°C as previously reported.[46,47,48] While the action of acetic anhydride in boiling pyridine gave both the acetylation products, heating gossypol with acetic anhydride and fused sodium acetate at 180°C produced a high melting pyrone.[49]

Bitter principles

An easy method for the isolation of corchorin, a bitter principle from jute (*Corchorus capsularis*) seeds, in good yield, consists in: (1) exhaustively extracting the crushed and de-fatted jute seeds with acetone in a Soxhlet, (2) taking the residue from acetone into water and treating it with lead acetate to remove precipitated volamite and saponin, (3) treating the aqueous filtrate with H_2S to remove lead and (4) collecting the deposited corchorin from the filtrate and crystallising it from dilute ethanol or methanol.[50]

A non-alkaloidal, non-glucosidic bitter principle $C_{21}H_{30}O_7$, m.p. 127° C containing an unsaturated lactone group, a somewhat inactive OH-group and one methoxy group, has been isolated from the chloroform extract of the de-fatted seeds of *Swietenia*

44 Rao, P.L.N. and Varma, S.C.L. (1951), *Ibid*, *V*., **10**B, 184.

45 Mitra, C. (1951), *Ibid*., *V*., **10**B, 235.

46 Carruth, F. E. (1918), J. Amer. Chem, Soc., **40**, 647.

47 Clark, E P. (1928), J. Biol. Chem., **76**, 229.

48 Miller, R.F., Butlerbaugh, D J. and Adams, R., (1937), J. Amer. Chem. Soc., 59, 1729.

49 Murty, K S and Seshadri, T.R. (1951), Proc. Ind. Acad. Sci., **34A**, 272.

50 Chaudhury, D.N. and Dutta, P.C. ((1951), J. Ind. Chem. Soc., **28**, 167.

mahogani.[51]

Andrographolide, $C_{20}H_{30}O_5$, the bitter principle from *Andrographis paniculata*, Nees., known as *Kalmegh*, is an unsaturated trihydroxy lactone containing: (1) a reduced naphthalene ring, (2) two ethylene double bonds, (3) three hydroxyl groups of which one is tertiary in nature, (4) an $\alpha:\beta$-unsaturated lactone system and (5) an exocyclic methylene group, in its molecule.[52] During a re-investigation of the preparation and properties of andrographolide, andrographolic and *iso*-andrographolic acids, barium salt of andrographolic acid, triacetyl andrographolide and bromo derivatives of andrographolide have been described.[53]

A crystalline bitter principle, *amarin*, $C_{19}H_{26}O_7$, m.p. 182° C, has been isolated in 0.12 per cent yield from the de-fatted seed kernel of *Luffa amara*, Roxb. (Hindi: *Karvitурai*). On hydrolysis with aqueous baryta, *amarin* yields an acid m.p. 263°C.[54]

A method for the extraction of *nimbidin* from nim (*Azadirach indica*, Linn.) seeds has been evolved. The so-called *nimbidin* is a mixture of at least three different constituents which have been separated by chromatographic method.[55]

Other plant products

A re-investigation of *cleridin*, the active principle from the leaves of *Clerodendron infortunatum* has shown that its formula is $C_{28}H_{40}O_8$ and not $C_{13}H_{18}O_3$ as previously put forth.[56] Out of the eight oxygen atoms, two are as ester combination, four as alcoholic hydroxyl groups, and the remaining two, in the absence of any alkoxy or carbonyl group, are as ether linkages.[57]

Swietenin, $C_{18}H_{24}O_5$, m. p. 256-58°C (decomp.), the non-bitter principle isolated from *Swietenia macrophylla* contains one

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51 Guhasircar, S.S. and Latif, K.A. (1951), *Ibid.*, **28**, 485.

52 Chakravarti, R.N. and Mrs. Chakravarti, D. (1951), Ind. Med. Gaz., **86**, 96.

53 Rangaswami, S. and Rao, V.S. (1951), J. Sci. Ind. Res. India, V, **10**B 201.

54 Chaudhry, G.R., Sharma, V.N and Siddiqui, S. (1951), *Ibid*, *V*., **10**B, 26.

55 Sengupta, A. C., Singh, S. and Majumdar, D.N. (1951), Ind. J. Pharm., **13**, 265.

56 Banerjee, H. N (1937), J. Ind. Chem. Soc., **14**, 51.

57 Chaudhury, D. N., Dutta, P. C. (1951), *Ibid.*, **28**, 295.

methoxyl group, one tertiary hydroxyl group and one unsaturated lactone system. On hydrolysis, the hydroxy acid of the lactone has been obtained. *Swietenin* has given a dibromide and a mono-acetoxymercuric derivative.[58]

The saponin, m. p. 300-301°C, isolated in 11 per cent yield from the pericarp of the seeds of *Balanites roxburgii*, Palanch., (Hingora seeds) has yielded a sapogenin, m. p. 197-99°C which has been identified as diosgenin. The saponin in a concentration of 1 in 60,000 has been found to be a fish poison.[59]

The petroleum (low boiling) and diethyl ether extracts of the root bark of *Crataeva nurvala*, Ham., (Hindi: *varuna*) have yielded the following four crystalline products: (1) lupeol, $C_{30}H_{50}O$; (2) sitosterol, $C_{29}H_{50}O$; (3) varunol, $C_{23}H_{46}O_2$; and (4) a colourless substance, $C_6H_{11}O$.[60]

An economical process for the manufacture of dulcitol from the root bark of *Pristimera indica* has been developed. The root consists of an outer yellow covering, an inner red bark and pith containing 0, 0.1 to 0.2 and 1.4 to 1.7 per cent dulcitol respectively.[61]

Pristimerin, the active principle isolated from the roots of *Pristimera indica* in 0.1 per cent yield has shown considerable *in vitro* activity against a large number of Gram-positive cocci. It is ineffective against Gram-negative organisms and is toxic when administered parenterally.[62]

The crystalline, water insoluble acid, *jatamanschic* acid, $C_{15}H_{20}O_2$ or $C_{15}H_{22}O_2$, m. p. 123°C, isolated in about 3 per cent yield from *Nardostachys jatamanschi* (Indian spikenard), has, on oxidation with potassium permanganate, yielded acetic acid and a dicarboxylic acid, m.p. 155°C. Dehydrogenation with selenium has yielded an intensely blue coloured liquid, the physical properties and colour reactions of which are indicative of an azulene

58 Guhasircar, S. S. and Chakravarty, T. (1951), *Ibid.*, **28**, 207.

59 Dhekne, V. V. and Bhide, B. V. (1951), *Ibid.*, **28**, 588.

60 Bhandar, P. R., Dhar, N. L. and Sharma, V. N. (1951), J. Sci. Ind. Res. India, **V**, **10B**, 195.

61 Bhatnagar, S. S. and Divekar, P. V. (1951), *Ibid.*, **V**, **10B**, 117.

62 *Idem*, (1951), *Ibid.*, **V**, **10B**, 56.

structure.[63]

Biochanin B, $C_{16}H_{12}O_4$, m.p. 256-257°C, one of the products isolated from the fresh germ of *Chana* and *Kabuli chana*, the ordinary and white varieties of *Cicer arietinum*, Linn., has been shown to be identical with formononetin, 7-hydroxy-4′methoxy *iso*-flavanone.[64]

A glucosidic principle has been isolated from *Dregea volubilis* Benth., (Hindi: *Nak chhikni*). It lowers the carotid blood pressure and has a mild stimulent action on organs having autonomic cholinergic nerve supply.[65]

The location of the methoxyl group in *teloschistin* isolated from the litchens, *Teloschistes flavicans*, at position 7 as well as the identity of *teloschistin* with *w*-hydroxyemodin-7-methylether have been rigidly established.[66] The Indian specimens of the lichens, *Parmelia tinctorum*, contain depsidones such as *nor*-stictic and salzinic acids besides atranorin and lecanoric acid, found in the foreign counterparts.[67]

From the analytical values for galacturonic acid and methoxyl content of purified pectin from pumpkin (*Curcurbita pepo*), pomelo (*Citrus pomelo*), guava (*Psidium guava*), and country pears (*Pyrus communis*), it has been shown that neither arabinose nor galactose is integral constituent of pectin and that all the four vegetables contain an identical pectin molecule. Analysis of the pectic acid from these pectins and determination of its equivalent weight confirm the identity of the basic structural unit of the pectin and indicate that the chain length of the pectic acid molecule is of the order of 50 to 100 galacturonic acid units.[68]

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63 Chaudhury, G. R., Sharma, V. N. and Siddiqui, S. (1951), *Ibid.*, **V**, **10**B, 48.

64 Bose, J. L. and Siddiqui, S. (1951), J. Sci. Ind. Res. India, **V**, **10**B, 291.

65 Gupta, J. C., Roy, P. K., Dutta, A. T. and Ray, G. K. (1951), Ind. J. Med. Res., **39**, 255.

66 Neelakantan, S., Rangaswami, S., Seshadri, T. R. and Shankarasubramanian, S. (1951), Proc. Ind. Acad. Sci., **33A**, 142.

67 Neelakantan, S., Seshadri, T. S. and Sankarasubramanian, S. (1951), J. Sci. Ind. Res. India, **V**, **10**B, 199.

68 Rangachari, P. N. (1951), Proc. Ind. Acad. Sci., **33A**, 100.

Thiodiamin isolated from the bark of *Crataeva roxburghii* and claimed to be useful for the treatment of cholera has been identified as N : N′-dibenzylthiocarbamide,[69] $C_6H_5.CH_2.NH.CS.NH.CH_2.C_6H_5$.

The mucilage from the dried tubers, *Curculigo orchioides*, obtained in 8.12 per cent yield comprises: mannose, glucose and glucoronic acid in the molecular ratio of 6 : 9 : 10. Results of a proximate analysis of the root powder are: moisture, 10.42; fat, 1.92; colouring matter, 3.28; proteins, 9.81; fibre, 15.70; non-fibre carbohydrates, 53.20, inorganic matter (by difference), 5.67 and ash content, 5.51 per cent.[70]

The root powder of *Asparagus racemosus* contains: moisture, 13.42; ether extract, 3.19; proteins, 2.95; saponins, 5.44; carbohydrates including uronic acid and free sugars, 52.89; crude fibre, 17.93; inorganic matter, by difference, 4.18; and ash, 3.92 per cent. The isolated and purified mucilage contains 39.2 per cent uronic acid; the presence of galacturonic acid also has been confirmed.[71]

Chromatographic examination of the hydrolysate of the polysacharides from *Meda* (*Gymnema aurantiacum*) showed the presence of fructose and galactose with the former as the major constitutent in it.[72]

Aloe fibre a promising substitute for jute-contains a remarkably low lignin content, a high fat and α-cellulose contents, contradicting the belief that the stiffness of lignocellulosic fibre is due to its high lignin, low fat and α-cellululose contents. From the study of the chemical composition of *Hibiscas cannabinus* fibres it appears that the stiffness of the aloe fibre is due to its high xylan and poliuronides contents and not to its lignin, α cellulose or fat contents.[73]

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69 Chakravarti, R. N. (1951). Ind. Med. Gaz., **86**, 152.

70 Rao, P.S., and Beri, R.M. (1951), Proc. Ind Acad. Sci., **34A**, 27.

71 Rao, P. S., Beri, R. M. and Budhiraja. R. P. (1951), J. Sci. Ind. Res India. V, **10B**, 261.

72 Mukherjee, S. and Srivastava. H.C. (1951), *Ibid*, *V*., **10**B, 324.

73 Das, B.B., Mitra, M.K. and Wareham, J.F. (1951). J. Ind. Chem Soc., **28**, 37.

It has been observed that the saponin obtained in 65 per cent yield from the aqueous extract of soapnut (*Sapindus mukorossi*) can be employed with advantage as a detergent in textile industry.[74] Preparation of tamarind (*Tamarindus indica*) seed kernel powder (T. K. Powder) and its utilization as a sizing material in the jute industry have been studied. Specifications for commercial T. K. Powder have been suggested.[75] Physical properties such as viscocity, gelatinization and film characteristics of T. K. paste have been investigated. The tensile and abrasion resistance properties of jute yarn sized with T. P. paste compare favourably with those sized with starches and flours. Further, it has been shown that the quantity of T. K. paste required to give satisfactory results is about half that of starches and flours normally employed.[76]

A study of the juice of a species of *Citrus limonis* (Hindi : *Jambhira* and *Khattia* or *Khatta* in Madhya Bharat) has shown that it contains citric acid, 6.44 per cent and ascorbic acid, 32.25 mg. per 100 c.c. of the juice.[77]

The dipole moments and the dielectric constants of anacardic acid and cardol have been determined and found to corroborate the chemical structure of these two constituents.[78]

An ion exchange resin from *Katha*, a crystalline substance obtained in 2 to 3 per cent yield from the aqueous extract of the bark of *Khair* (*Acacia cateshu*, Willd) trees has been prepared and its adsorptive capacity towards Ca, Sr, Ba and Mg ions has been estimated. The results show that Ca-ion adsorption by the resin is higher from calcium-hydroxide than from calcium chloride. Mg-ion is adsorbed more from magnesium sulphate than from magnesium chloride. Ba-ion is adsorbed sparingly and Sr-ion is not adsorbed at all.[79]

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74 Uppal, I S. and Mehta, R L. (1951), J. Sci. Ind. Res. India, V. **10**B, 190.

75 Macmillan, W.G. and Chakravarti, I.B. (1951), *Ibid*, *V*, **10**B, 13.

76 Idem, (1951), *Ibid.*, *V*, **10**B. 270.

77 Thomas Oommen, P. (1951), Indian J. Pharm. **13**, 120.

78 Krishnamurthy, S. (1951), J. Indian Chem. Soc. **28**, 193.

79 Bhatnagar, M.S. and Singh, B.P. (1951) J. Sci. Ind. Res. India, V. **10**B, 25.

VITAMINS

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Even at the risk of being blamed for an undue sense of optimism, the reviewers would venture to say that progress in this field during the current year has been somewhat noteworthy. Mention may be made specifically of the contributions to knowledge made by several workers with respect to the B-group of vitamins, particularly niacin, folic acid and vitamin B_{12}. It may, perhaps, be stated with some measure of confidence that there is a greater awareness to the metabolic importance of vitamins and the hope may be expressed that with due encouragement and availability of funds one could look forward to more fruitful years to research ahead. Vitamins in milk and milk products have been reviewed under the sections "Dairy Science" and "Animal Nutrition."

Provitamins and Vitamin A

Investigating the site of conversion of cryptoxanthin to vitamin A in the rat, Patel *et al* [1] attributed this function to the intestinal wall just as in the case of Beta-carotene. On oral administration no trace of the former was found in liver whereas when injected intra-peritoneally most of it could be recovered in liver. Zeaxanthin was, however, not found to be converted into vitamin A or stored in the form of a carotenoid.

When relatively large amounts of polycis compounds, pro-r-carotene and prolycopene were administered [2] to chicks and hens some 80% were found to be destroyed and the rest excreted in faeces. Far-reaching bio-stereoisomerization took place yielding all-trans and some new-forms of the compounds administered,

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1 Patel, S. M., Mehl, J. W. and Deuel, H. J. (Jr.) 1951 Arch. Biochem., **30**. 103.

2 Deuel, H. J., Jr., Ganguly, J., Koe, B. K. and Zechmeister, L. (1951), Arch. Biochem., **33**, 143.

besides poly-cis isomers possessing more cis double bonds than the starting material.

The effect of thyroxine and thiouracil on the metabolism of carotene was studied by Chanda *et al* [3,4,5] in cows and goats. Thyroxine increased the rate of metabolisation of carotene reducing its elimination in faeces ; it increased the ratio of vitamin A : carotene in milk. Thiouracil had an inhibitory effect on the transformation of carotene to the vitamin. When lactating cows were kept on a diet free from carotene, its faecal excretion was reduced to traces within 6-8 days. Reinstatement of carotene induced a rapid reappearance in the faeces. This reappearance was hastened by thiouracil but delayed by thyroxine suggesting that the digestibility of carotene by both cows and goats was increased by thyroxine while thiouracil had an adverse effect.

A study comparing the absorption of vitamin A from different fish liver oils by rats is reported by Acharya and coworkers.[6] The extent of absorption was found to depend on the source. The storage in liver increased with dose upto 400 blue units beyond which the percentage stored was found to decline.

Chanda and Owen [7] examined the nature of vitamin A activity in human milk. Most of the activity was due to vitamin A itself of which about 8% was present as the alcohol while 7-15% of the activity was due to alpha and beta-carotenes.

Dalvi and Morton [8] reported the isolation of neo vitamin A and preparation of neo-retinene by its oxidation. Occurrence of this in fish liver oils may introduce some error in correct assessment of vitamin A potency by spectroscopic methods.

The spectroscopic method for the assay of vitamin A was

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3 Chanda, R., Clapham, H. M. and Owen, E. C. (1951) Biochem. J., **50**, iii.

4 Chanda, R., McNaught, M. L. and Owen, E. C. (1951) *Ibid.*, **48**, xii.

5 Chanda, R., Clapham, H. M. McNaught, M. L. and Owen, E. C. (1951), *Ibid.*, **50**, 95.

6 Shet, S. W., Acharya, B. N. and Acharya, B. G. S. (1951), Ind. J. Pharm., **13**, 159.

7 Chanda, R., and Owen, E. C. (1951), Biochem. J., **48**, xiii.

8 Dalvi, P. D. and Morton, R. A. (1951), *Ibid.*, **50**, 43.

exhaustively investigated by Cama *el al* [9] including the calibration of spectrophotometer, determination of spectra in various solvents and interference due to related substances. The problem of determining vitamin A has been generally reviewed.

Thiamine and Riboflavin

The urinary excretion of thiamine and riboflavin by 26 patients showing definite signs of vitamin B deficiency was determined by Chitre and Nadkarni.[10] The effects of varying doses of thiamine and riboflavin were studied on the excretion as well as on liver functions. The treatment was accompanied by an improvement in liver functions proportional to the dosage indicating important rôle for these vitamins in liver function.

Influence of various fertilisers on thiamine content of rice was studied by Sathe *et al.*[11] A combination of leaf nitrogen and P_2O_5 proved the best. Added K_2O induced no further improvement. The same workers [12] studied the effect of milling on thiamine and phytic acid contents of rice. Although milling removes part of the thiamine, it also results in removal of phytic acid which may otherwise produce an imbalance in Ca : P ratio in diet. Also the loss of phytic acid is greater in initial stages so that a certain degree of milling is advisable.

Thiamine and riboflavin contents of different tissues of seven varieties of salt water fish were determined. Wide species and seasonal variations were encountered.[13]

De and Roy [14, 15] investigated the effects of different carbohydrates as well as of protein levels on biosynthesis of riboflavin in albino rats. Of the carbohydrates studied, lactose was the most efficient. Endogenous faecal as well as urinary excretions were

9 Cama, H. R., Collins, F. D. and Morton, R. A. (1951), *Ibid.*, **50,** 48.

10 Chitre, R. G. and Nadkarni, B. Y. (1951), Ind. J. Med. Sci., **5,** 67.

11 Sathe, V., Venkitasubramanian, T. A. and De, S. S. (1951), Science and Culture, **17,** 134.

12 Sathe, V., Venkitasubramanian, T. A. and De, S. S. (1951), Current Science, **20,** 153.

13 Pradhan, V. and Chitre, R. G. (1951), Indian J. Med. Sci., **5,** 645.

14 De, H. N. and Roy, J. K. (1951), Indian J. Med. Res., **39,** 73.

15 De, H. N. and Roy, J. K. (1951), *Ibid.*, **39,** 83.

depressed by high protein diets. This intestinal synthesis was greater in young rats than in adult ones. Most of the vitamin synthesised was excreted unabsorbed. Although sulpha drugs depressed the synthesis, the vitamin contents of liver and kidney were unaltered on any diet.

Certain moulds habituated to grow on cocoanut are reported [16] to elaborate thiamine in fair amounts.

A method of isolation of the antithiamine factor from mustard (*Brassica juncea*) has been developed by Reddi.[17] The activity was found to increase with concentration but the action was instantaneous and independent of pH and time. The factor was quite resistant to heat and was thus non-enzymic. The major portion of activity was dialysable.

A comparative study of stability of thiamine mono-nitrate and hydrochloride in pharmaceutical preparations is reported.[18] The properties are comparable except that nitrate is more stable in presence of iron salts.

Niacin

The metabolic inter-relationship between vitamins is brought out in a remarkable manner by the investigations of Henderson, Weinstock and Ramasarma [19] demonstrating the rôle of certain members of the B-vitamins in the conversion of tryptophane to niacin. Thus vitamin B_2 or B_1 deficient rats excreted much smaller amounts of urinary quinolinic and nicotinic acids following administration of tryptophane or kynurenine. There was no decrease when 3-hydroxy anthranilic acid was the starting substance, suggesting that these vitamins function in the conversion of kynurenine to 3-hydroxy anthranilic acid. A support for these observations comes from the interesting work of Sarma and

16 Ramakrishnan, C. V. and Srinivasan, K. S. (1951), Science and Culture, **16**, 320.

17 Reddi, K. K. (1951), Proc. Nat. Inst. Sci., **17**, 39.

18 Esh, G. C. (1951), Ind. J. Pharm., **13**, 222.

19 Henderson, L. M. Weinstock, I. M. and Ramasarma, G. B. (1951), J., Biol. Chem., **19**, 189.

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coworkers[20] with germinating pulses. Addition of desoxy pyridoxine, an analogue antagonist of pyridoxine, inhibits the biosynthesis of niacin during germination by various pulses. This inhibition is overcome by the addition of pyridoxine.

According to De and Datta[21] a greater portion of the conversion of tryptophane to niacin takes place in the intestine as a result of microbial activities since it is markedly depressed by sulpha guanidine. Tryptophane enhances the normal urinary excretion by about three times. Most of the vitamin elaborated is absorbed through the intestine.

A chemical method for the quantitative estimation of the bound form of niacin in cereals using PABA as the coupling agent has been developed by Choudhuri[22] whereas Kodicek and Reddi[23] have studied various aspects of paper chromatography of niacin derivatives.

Folic acid and vitamin B_{12}

The reported animal protein factor activity of vitamin B_{12} was tested by Marfatia and Sreenivasan[24] by studying the way it influences the biological value of low quality protein diets with rats. Vitamin B_{12} enhanced both digestibility coefficient and biological value of the diet. Patwardhan and coworkers,[25] however, did not find any significant difference in urinary and faecal nitrogen excretion after B_{12} administration to two human adults. Sahasrabudhe and Rao[26] observed the stimulative effect of vitamin B_{12} in protein and nucleic acid synthesis in liver of fasted rats. Liver protein nitrogen increment over fasted level was raised by 50 per cent and total nucleic acids by 27 per cent in

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20 Shanmuga Sundaram, E. R. B., Ranganathan, G. and Sarma, P. S. (1951), Current Science, **20**, 122.

21 De, H. N. and Datta, P. Jr. (1951), Indian J Med. Research, **39**, 62.

22 Choudhuri, D. K. (1951), Science and Culture, **17**, 270.

23 Kodicek, E. and Reddi, K. K. (1951), Nature, **168**, 475.

24 Marfatia, U. and Sreenivasan, A. (1951), Curr. Sci., **20**, 128.

25 Tulpule, P. C, Rama Sastri, B. V. and Patwardhan, V. N. (1951), *Ibid.*, **20**, 266.

26 Sahasrabudhe, M. R. and Rao, M. V. L. (1951), Nature, **168**, 605.

groups receiving B_{12} than in control. The rise in desoxy-ribonucleic acid is particularly noteworthy as it is not changed even on fasting.

The rôle of folic acid and vitamin B_{12} in transmethylations was emphasised and elucidated by the investigations of Sreenivasan and associates.[27,28] These workers found that both *in vitro* creative synthesis by rat liver homogenates and creatine content of liver muscles and urine were appreciably increased by dietary addition of folic acid or B_{12}, both together having an additive effect. The rôle of folic acid in this as well as in nicotinamide metabolism and its partial replacement by methanol or formate suggested the possibility of its functioning in methyl biogenesis from administered precursors. Subsequent work showed that in folic acid deficient mice there occurs no more synthesis of choline or methionine, from exogenous precursors like methanol or serine as a result of folic acid supplementation than from metabolically derived precursors. Folic acid, thus, seems not to be concerned directly in methyl synthesis but rather to methyl conservation and hence to increased transmethylation through inhibition of methyl degradation to formate. Based on these considerations, Sreenivasan [28] postulated an interrelationship between folic acid and vitamin B_{12} in transmethylations that B_{12} may promote actually methyl synthesis from precursors besides being implicated in choline to betaine and to methionine transformations, whereas folic acid is responsible in checking the drain on methyl economy.

A case of Addisonian pernicious anaemia is described by Konar.[29] Good response was observed to liver and vitamin B_{12}.

Vijayaraghavan and Dun [30] tested the relative erythropoietic potencies of the crystalline vitamins B_{12}, B_{12a} and B_{12b} on mice made anemic with phenyl hydrazine. All three effected nearly identical increases in red blood cell counts.

27 Fatterpaker, P. Marfatia, U. and Sreenivasan, A. (1951). *Ibid*, 167 1067.

28 Sreenivasan, A, (1951). Current Science, 20, 319.

29 Konar, N.R. (1951), Indian Med. Gaz., 86, 237.

30 Vijayaraghavan, P. K. and Dunn., M. S. (1951). Arch Biochem, 31. 248.

A test for assessing the potency of liver extracts by determining the amount required to prevent the drop in R.B.C. and hemoglobin induced by administration of lead in rabbits is described.[31] Crystalline B_{12} was also able to effect a reversal of the effect of lead, graded response being obtained with increasing concentrations.

A microbiological assay of vitamin B_{12} with *Lactobacillus lactis* (Dorner) has been described by De and Mukerji.[32] 110 samples of commercial liver extracts have been analysed by this method and the authors recommended it for quick and correct evaluation of liver extract potencies. Specificity of this method, however, is questionable in view of the reported interference due to other substances particularly the desoxy ribosides and the variation in response with factors like oxygen tension. There is also no suitable standard procedure for the complete liberation of the vitamin from naturally occurring bound forms which may be unavailable to the organism. A strict parallelism between B_{12} content and hemopoietic potency of liver preparations is yet to be shown.

Contrary to the reported inhibitory effect of folic acid *in vivo* and *in vitro* on xanthine oxidation, it is observed by Fatterpaker and Sreenivasan [33] that in presence of a catalase preparation from pigeon liver the xanthine oxidase activity of a purified milk enzyme preparation is actually stimulated by folic acid in small quantities comparable to those present in body fluids and tissues. Williams, Chitre and Elvehjem [34] reported a similarity in the action of folic acid and its analogue antagonist aminopterin on rat liver metabolism (*in vitro*). Initially both depressed the O_2-uptake followed by a stimulation of oxidation over that of controls. Folic acid had no effect (*in vitro*) on d-amino acid oxidase of rat liver, although dietary folic acid is known to inhibit the liver enzyme. The *in vivo* effect on d-amino acid oxidase is thus indicated to be only indirect.

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31 Klaveren, F. W. von and Shrivastav, P. C. (1951), Curr. Sci. 20, 208.

32 De, S. P. and Mukerji, B. (1951), Indian Med. Gaz. 86, 403.

33 Fatterpaker, P. and Sreenivasan, A. (1951), Nature 167, 149.

34 Williams, J. N., Jr., Chitre, R. G. and Elvehjem, C. A. (1951), J. Biol. Chem., **190**, 455.

The effect of aminopterin on the uptake of radio active phosphorus by some endocrine tissues of rat *in vivo* forms the subject of an investigation by Venkataraman and co-workers.[35] No difference was noted in case of testes and thymus by aminopterin treatment. Thyroid showed some 50 per cent increase in the uptake when aminopterin treatment was in the form of a single massive dose and 100 per cent when the dose was cumulative possibly due to a heightened metabolic activity of the secretory tissue. Adrenals showed a strange behaviour in that the uptake was increased by about 40 per cent following a single dose of aminopterin, but there was a significant lowering when aminopterin administration was gradual.

The elaboration of folic acid like activity by growing cells of *Lactobacillus arabinosus* was studied by Mitbander and Sreenivasan.[36] In addition to the reported stimulatory action of PABA on this synthesis a marked enhancement was observed with xanthine and with biotin or Tween 80, whereas other purines, pyrimidinic and B-vitamin supplements had no effect. The nature of the activity was studied by liquid-liquid partition and inhibition analysis studies. The factor was found to stimulate growth of *Leuconostoc citrovorum*. All these point out the presence of part of the folic acid activity in the form of *citrovorum* factor; the physiological significance of this factor has been discussed, by Rege and Sreenivasan.[37]

Biotin

Sivasankar and Sarma[38,39] noted the requirement of the rice moth larva (*Coreyra cephalonica* St) for biotin which could be replaced completely by oleic and vaccenic acids. Possibility of using the larvae for assay of biotin is indicated. Fat, cholesterol and total nitrogen accumulated during biotin deficiency. The

35 Samarth, K. D., Baxi, A. J., Baliga, B. R. and Venkataraman, P. R. (1951), Current Science, **20**, 120.

36 Mitbander, V. B. and Sreenivasan, A. (1951), *Ibid.*, **20**, 129.

37 Rege, D. V. and Sreenivasan, A. (1951), Science and Culture, **17**.

38 Siva Shankar, D. V. and Sarma, P. S. (1951), J. Sci. Ind. Research, **10B**, 3.

39 Siva Shankar, D. V. and Sarma, P. S. (1951), *Ibid.*, **10B**, 294.

capacity of larvae to desaturate palmitic and stearic acids lowered in biotin deficiency. In the case of *Neurospora crassa* the same authors observed that oleic acid replaces biotin only to a limited extent while vaccenic acid had no biotin activity at all.

Vitamin C

Distribution of vitamin C in some *gastropods* was investigated by Meenakshi.[40] The appearance of vitamin C in *Pila virens* (Lamarck) was noticed on 12th-14th days but not in the starved animals. Feeding glucose enhanced the formation. Certain moulds grown on cocoanuts were found to synthesise ascorbic acid in the mycelia though very slight amounts could be detected in culture media.[17]

Sarma and coworkers[21] noted inhibition of ascorbic acid formation during germination of pulses on treatment with desoxy pyridoxine. This could be reversed by pyridoxine. The effect of the antagonist was apparent in presence of glucose but not mannose indicating that vitamin B_6 may be involved in the conversion of glucose to mannose probably an 'coracemare.'

Vitamin C was found to be excreted in the medium by leguminous seeds during soaking prior to germination.[41] The excretion was observable even before the radical had pierced out suggesting it to be due to osmosis through the seed coat.

Enhanced growth of excised jute embryos was obtained as a result of ascorbic acid addition to the nutrient medium. The effect was more pronounced in case of roots.[42] Lowered values were reported for cholesterol and ascorbic acid in adrenals of scorbutic guinea pigs.[43]

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40 Meenakshi, V. R. (1951), Current Science, **20**, 136.

41 Sreenivasan, A. and Wandrekar, S. D. (1951), Proc. Ind. Acad. Sci., **34**, 267.

42 Mitra, J. and Datta, C. (1951), Science and Culture, **16**, 428.

43 Banerjee, S. and Deb, C. (1951), J. Biol. Chem. **190**, 177.

FOOD TECHNOLOGY

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With the establishment of a Central Food Technological Research Institute at Mysore by the Government of India, it is not surprising that the Executive Committee of the Society of Biological Chemists, India, felt the need for a separate section in the Annual Review dealing with researches in the field of Food Technology. It may also be hoped that an impetus would be given to the study of these problems, thus helping to solve the acute food shortage now prevailing in the country.

Bose[1] has rightly pointed out that even the small number of technologists now available in the country find very little scope for employment as there are no food industries where the technical skill of these trained personnel could be used to advantage. Out of a total of 454 licensed food factories, all except 26 are run on cottage industry scale. He has emphasised the necessity of devoting greater attention to food preservation especially as facilities for quick transportation are not available. Efficient preservation with due consideration to the cost of the preserved material, would serve to avoid the enormous wastage of food.

Jiwan Singh Pruthi and Girdhari Lal[2] have studied the relative efficiencies of different methods of preservation and storage on the vitamin C content, colour, sedimentation and flavour of citrus fruit juices. Seven varieties of citrus fruit juices packed as such and with 5% cane sugar as also after deaeration were preserved by (a) holding pasteurisation at 175°F ; (b) overflow pasteurisation at 175-180°F ; (c) flash pasteurisation at 195-200°F ; and (d) addition of sodium benzoate and SO_2 at 1,000 and 700 p.p.m. respectively. The packages were stored at 0° to 2°C, 25°C and 35 to 37°C. Ascorbic acid was determined by the selective

1 Bose, A. N. (1951), Science and Culture, **17**, 147.

2 Jiwan Singh Pruthi and Girdhari Lal (1951), J. Sci. Ind. Research, **10B**, 36.

condensation method employing formaldehyde. It was found that deaeration of juices before packing and flash pasteurisation coupled with packing in plain cans in preference to bottles helped in better retention of vitamin C. Storing at 0 to—2°C resulted in a better retention of ascorbic acid and retardation of discolouration than the other temperatures studied. Addition of cane sugar increased the discolouration of the juice and also caused a rapid loss of ascorbic acid.

Jain, Bhatia and Girdhari Lal [3] have studied the preparation and uses of sweet potato flour. The outer skin had to be removed to obtain a white flour. Necessary precautions should also be taken to see that contact with iron was avoided as otherwise discolouration would result. Peeling was done by treatment with lye or steam as also by hand scraping. While the hand-scraped product gave a raw taste, the lye or steam treated material was bright yellow and there was no raw taste. Drying in a dryer at 145-150°F. for 8-10 hours yielded a more satisfactory product than the sun-dried material. Such a flour was found to be a good substitute for corn flour, wheat flour and rice starch and could be used for milk jelly puddings, cakes and biscuits. A mixture of sweet potato flour and wheat flour in the proportion of 1 : 4 was found best suited for preparing *chapatis*.

Mathur [4] has investigated the following aspects of potato storage : (a) the physiological loss in weight of mature potatoes stored at different temperatures and relative humidity, (b) the effect of depth of piling on physiological loss in weight of tubers, (c) storage of seed and table potatoes, (d) effect of tuber size on storage life, (e) effect of storage temperature on starch, sucrose, and reducing sugars in stored potatoes, (f) effect of mechanical injury to tubers on loss in weight during storage and (g) effect of heat treatment of potato tubers prior to storage. He found the minimum loss when the storage temperature was 41°F. Seed potatoes stored at 50°F. gave the maximum yield of tubers when

3 Jain, N. L., Bhatia, B. S. and Girdhari Lal (1951), J. Sci. Ind. Research, **10-A**, 332.

4 Mathur, P. B. (1951), J. Sci. Ind. Research, **10B**, 224.

compared with those stored at other temperatures. For adequate storage at 90°F., 80-85% relative humidity was necessary. Storage at 32°F. was found to produce the maximum quantity of sucrose. Undamaged potatoes lost the least weight and heat treatment prior to storage also helped to minimise the loss during storage.

Moorjani and Bhatia[5] have dealt with some of the recent methods of food processing and preservation. In regard to cooking and sterilisation, these authors have stated that application of radar energy would effect temperature alterations in the minimum time, thus helping to retain the nutritive value of the product to the maximum possible extent. Further, use of X-ray irradiation as a means of sterilisation has been widely used for medicinal preparations. But the application of this method to food would be limited as 'radiation taste' might be imparted to the food products on continuous exposure to X-ray. These authors have also discussed a number of other dehydration processes of immediate importance to the food technology industry.

Chattopadhaya and Banerjee[6] have stated that pulses are rich sources of choline while cereals are poor sources. They found an increase in the choline content of both cereals and pulses during germination.

Jain *et al*[7] have reported that cooking cashew apple in 2% common salt solution for 3 to 4 minutes or steaming at 5 lbs. for about 5 minutes removed the astringent taste of the fruits. Addition of lime juice was found to impart a pleasant flavour and aroma. These authors have also detailed the method of processing the fruit for obtaining juice, syrup, jam and candied fruit. Cashew apples are generally available only during a very short season at a few places. It is therefore, important to preserve the fruit in one of these forms so as to make them available throughout the year. The high content of ascorbic acid in cashew apples would further add to the nutritional requirements.

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5 Moorjani, M. N. and Bhatia, D. S. (1951), J. Sci. Ind. Research, **10A**, 250.

6 Chattopadhyaya, H. and Banerjee, S. (1951), Food Research, **16**, 230.

7 Jain, N. L., Bhatia, B. S., Anand, J. C. and Girdhari Lal (1951), J. Sci. and Ind. Research, **10A**, 209.

Sadana [8] has suggested a method of preparing a concentrated food suitable for human consumption from leaf wastes by anaerobic digestion brought about by soil organisms (*Clostridium roseum*). Water was added to washed and shredded leaf so as to have a solid content of 8-10%. After steaming for 15 minutes and cooling, the contents were inoculated with 8-10% (by vol.) of a 18-hour broth culture of *C. roseum*. The decomposition was carried out in an atmosphere of carbon dioxide at 37°C. The final product was obtained after co-agulating, centrifuging and drying.

The food is reported to be fairly rich in both protein and carotene, the dry concentrate analysing to : protein, 35-63%; calcium, 1-5%; phophorus, 0-1 - 0.3%; Iron, 150-400 mgms.%.

Council of Scientific and Industrial Research News [9] report a number of research projects relating to food technology in progress at the Central Food Technological Research Institute, Mysore. Further a process (details not given) has also been perfected for obtaining good quality casein from spoilt milk powder. There is also a report covering the production of vegetable milk curd from groundnut. Best quality groundnut is employed for the production of the milk which is deodorised and fortified with minerals before curdling.

8 Sadana, J. C. (1951), J. Sci. Ind. Research, 10B, 214.

9 C. S. I. R. News (1951), 1.

HUMAM NUTRITION

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Interest in the field of human nutrition has been maintained during the year under review. Problems of immediate importance in India, such as epidemic dropsy, cirrhosis of the liver, fluorosis, etc., have received special attention at the hands of investigators. The nutritive value of various foodstuffs and substitute foods, and proteins and fats, has also been a subject of intensive study.

Food problem, diets and diet surveys

Sankaran [1] has discussed the food problem of the country in great detail. He has questioned the wisdom of pursuing the programme of self-sufficiency in food through reclamation of waste land, since, in the author's opinion this would require 350 million more acres of land, on the basis of 1.5 acres per capita. He suggests the production of synthetic foods to solve the problem and has discussed in detail the production of wood sugar, food yeast and synthetic fat. He has also suggested the possibility of production of synthetic vitamins and vitamin concentrates in India, and has indicated the approximate amounts of these required in this country to keep the present population in good health.

Devadas and Sutton [2] studied the effect of supplementing fat extracted egg yolk and fresh egg yolk to a 'poor rice diet of South India' on the growth of young rats. The supplementary value of fresh egg yolk was considerably higher than that of fat extracted egg yolk. Much of the defect of the diet supplemented with fat extracted egg yolk could be corrected by addition of vitamin A and riboflavin to the diet. In further experiments, they [3] found that

1 Sankaran, G. (1951), Presidential address to the Medical and Veterinary Section of the Indian Science Congress, Bangalore.

2 Devadas, Rajammal, P. and Sutton, T. S. (1951), **Ind. Jour. Med. Res., 39, 51.**

3 *Idem.* (1951), *Ibid.*, **39**, 59.

additions of vitamin-free casein and lactalbumin stimulated growth and food intake of rats fed the basal rice diet supplemented with egg yolk extract. However, it led to certain skin manifestations which could be rectified only by the addition of riboflavin to the diet.

The results of diet surveys that have been carried out in India between the years 1935 and 1948 are compiled together in a special report of the Indian Council of Medical Research.[4] Some 843 groups of families have been covered in the survey. The figures obtained in the diet surveys have been submitted to statistical analysis which further enhances the value of the report. The intake of protective foods, such as milk, flesh foods, fruits, etc., in most of the groups of families surveyed, was much below the desired level ; two-thirds of the families did not consume any fruits and nuts at all. A quarter of the family groups did not consume milk and milk products or leafy vegetables. Only in about one-fifth of the groups of families surveyed was the intake of pulses and 'other vegetables' up to the level recommended by the Nutrition Advisory Committee of the Indian Council of Medical Research. The families have been classified as urban and rural, and the various foodstuffs consnmed are reported in ounces per 'consumption unit' per day. Where the results of any of the surveys have been already published in journals, these are listed separately under the heading 'References'. A booklet[5] which is expected to serve as a sort of directive to workers engaged in diet surveys in this country has been published by the Indian Council of Medical Research. This will help in uniform methods being adopted when diet surveys are carried out in different parts of the country and thus fulfils a long felt need by workers in this field.

The Indian Council of Medical Research has published another

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4 I. C. M. R. Special Report No. 20 (1951). 'Results of Diet Surveys in India, 1935 to 1948'. Price Rs. 2.

5 I. C. M. R. Special Report No. 21 (1951). 'A Note on the Management and Technique of Diet Surveys in India.' Price Re. 1.

special report reviewing nutrition studies in India.[6] It is written in simple non-technical language and is divided into five sections. The first section gives a brief description of the historical aspect of nutrition research in this country. Public health nutrition work in the States, and the organization at the centre and in the armed forces form the subject matter for the second section. Section three deals with researches in nutrition in different fields, while section four is devoted to studies in food technology. The section which would be found to be very valuable by nutrition workers in this country is section five which gives an up-to-date bibliography of nutrition work in India under various subjects.

Clinical, Physiological and Field Studies

The use of vitamin B_{12} in treating cases of infantile cirrhosis has received attention. Sunder Rao, Krishnaswamy Rao and Anderson[7] treated seven cases of infantile cirrhosis with vitamin B_{12}; they noted distinct clinical improvement in all the cases, though in no instance did the liver regress to the point where it was no longer palpable. Doraiswamy, Naidu, Rao and Subrahmanyan[8] treated twelve cases of infantile cirrhosis of various degrees of severity with vitamin B_{12} in doses of 30 microgrammes twice a week. A low fat diet was prescribed. In advanced cases with jaundice and ascitis an oral supplement of 25 to 30 grams of casein hydrolysate was given daily. All the early cases recovered completely after 4 to 5 weeks of treatment. The results in advanced cases of cirrhosis complicated with jaundice were not so promising but still the depth of jaundice became less and the period of survival of the infants after the appearance of jaundice was much longer than the control.

Roy[9] carried out a field investigation lasting six months in an outbreak of lathyrism in Madhya Pradesh in 1945. He found that

6 I. C. M. R. Special Report No. 22 (1951). 'A Review of Nutrition Studies in India.' Price Rs. 2.

7 Sunder Rao, A. R., Krishnaswamy Rao, S. and Anderson, R. K. (1951): Curr. Sci. **20**, 41.

8 Doraiswamy, T. R., Naidu, V. R., Lakshminarayan Rao, M. V. and Subramanyan, V. (1951): Curr. Sci., **20**, 183.

9 Roy, D. M. (1951), Ind. Med. Gaz., **86**, 263.

Lathyrus sativus was responsible for the disease and not the vetch, *Vicia sativa*; and that young adult males of the poor agricultural labour class were more susceptible than females, children and old people. *Lathyrus sativus* had to be consumed in a proportion of 40 per cent or more in the form of *chapatis* for 1 to 3 years before the onset of the disease; when *Lathyrus sativus* was consumed in the diet for years to the extent of 6 per cent in the form of cooked dhal no harm resulted from it.

Chakravarty and Chaudhuri [10] administered argemone oil to monkeys both by stomach tube and by injection and produced in them clinical symptoms of epidemic dropsy. When applied to the skin, the oil produced changes which showed that the oil was absorbed from intact healthy skin; further, the histological appearance of the tissue simulated that of human epidemic dropsy.

Lokre [11] examined the blood of 25 young healthy students of 20 to 24 years for serum sodium and potassium and has reported the average value to be 336.84 mg., and 18.86 mg. per 100 ml., respectively. Chakravarti and Mitra [12] have determined the nitrogenous constituents of blood and of urea clearance of 100 normal subjects in Uttar Pradesh. Their values for 100 ml. of blood were, urea 20 to 50 mg., N.P.N. 18 to 45 mg., protein 5.44 to 8.1 g. Urea clearance was C_m 74 to 120 per cent and C_s 45 to 120 per cent. Patel, Mehl and Deuel [13] report that similar to B-carotene, cryptoxanthin also gets converted to vitamin A in the intestinal wall of the rat when this is fed by mouth. Feeding the animals with sulphauxidine prior to the dose of cryptoxanthine had no effect on the rate of conversion to vitamin A. Unlike carotene, however, cryptoxanthin did not appear to be absorbed as such, since its presence could not be detected in blood or liver.

Sarkar and Nandi [14] have suggested a rapid fluorescence test for detecting the presence of argemone oil in mustard oil even

10 Chakravarthy, N. K. and Chaudhuri, R. N. (1951), Ind. Med. Gaz. **86**, 392.

11 Lokre, R. J. (1951), Ind. Med. Gaz., **86**, 45.

12 Chakravarthi, M. G. and Mitra, S. (1951), Ind. Med. Gaz., **86**, 343.

13 Patel, S. M., Mehl, J. W. and Deuel, Jr. H. J., (1951), Arch. Biochem., **30**, 103.

14 Sarkar, S N. and Nandi, D. L. (1951), Curr. Sci., **20**, 232.

when it occurs in concentration of only 0.025 per cent. This test which is claimed to be specific for argemone oil is based on the pinkish fluorescence seen in ultra violet light when HCl and ethyl alcohol react with the oil. Prasad [15] has suggested a method based on the principle of air elutriation for separating mustard seed from commercial adulterated samples containing argemone seeds. Om Prakash, Ram and Brahma Prakash [16] have devised a simple method for removing the toxic alkaloids of argemone oil from adulterated mustard oil. The method consists in treating the oil with 20 per cent ferric chloride solution, keeping the mixture on a boiling water bath and then filtering. A further treatment of the oil with Fuller's earth improved the colour and ensured freedom from traces of ferric chloride. For oils containing up to 5 per cent argemone oil, addition of 20 per cent ferric chloride solution to the extent of 10 per cent on the weight of the oil was found to be sufficient. Lal [17] found after an investigation that only the mustard seeds imported into Bihar were adulterated with argemone seeds; the mustard seeds grown within the state of Bihar were not found to be contaminated with argemone seeds.

Nutritive Value and keeping Quality of Foodstuffs

Subramanian and Srinivasan [18] find that the seeds of *Amaranthus panniculatus* which are consumed by some sections of the poorer people are rich in protein and calcium; the bilogical value of the proteins of the seeds as determined by the balance sheet method was found to be about 80. Mukherji and Srivastava [19] find the polysaccharide in 'Meda' tubers (*Gymnema aurantiacum*) to be a fructosan of the type of inulin. Gopalakrishnan [20] assayed four different species of prawns of the Madras coast for their moisture and fat contents. The moisture varied from 72.6 7% to 77.86 % and the fat from 0.89 % to 1.15 %; differences due to sex were irregular and not marked.

15 Prasad, S. (1951), Jour. Sci. Indus. Res. **10B**, 144.

16 Om Prakash, Ram, A. and Brahma Prakash (1951), Curr. Sci., **20**, 16.

17 Lal, S. B. (1951), Ind. Med. Gaz., **86**, 317.

18 Subramanian, N. and Srinivasan, M. (1951), Curr. Sci., **20**, 294.

19 Mukherji, S. and Srivastava, H. C. (1951). *Ibid.*, **10B**, 324.

20 Gopalakrishnan, V. (1951). Curr. Sci., **20**, 331.

Hirwe and Magar [21] found that the growth of rats were more when fed on Bengal gram autoclaved for fifteen minutes than when fed the unautoclaved samples. No difference was noted between lentils autoclaved and unautoclaved. The authors suggest that autoclaving possibly destroys a trypsin inhibitor in Bengal gram. Gaitonde and Sohonie [22] report that field bean contains a trypsin inhibitor which loses its activity on autoclaving the bean for 20 minutes at 15 pounds pressure.

Protein, Fat and Carbohydrate Metabolism

With the help of paper chromatography, Roberts and Wood [23] have studied the free amino acids and amides in fresh and withered tea leaves. They found that there is a general increase in all the amino acids and amides in tea leaves due to withering which is the first process in the manufacture of tea leaves; of the amino acids, aspartic and glutamic acids are the most abundant both in the fresh and withered tea leaves. The report of Lal [24] that Bengal gram and ragi (*Eleusine coracana*) are totally deficient in threonine has come in for criticism at the hands of Baptist.[25] Baptist determined the threonine content of ragi both by the periodate oxidation method and the micro-biological assay using *Streptococcus faecalis* and reports the value to be 3 per cent of total nitrogen. Chandran and Damodaran [26] conclude from their experiments that isoleucine is essential for haematopoiesis in rats. They found that normal animals kept on an isoleucine-free diet for a few weeks developed anemia; in rats suffering from experimental anemia, regeneration of erythrocytes and hemoglobin were greatly reduced in the absence of isoleucine in the diet. The quantity of isoleucine required for maintenance of weight of rats was found to be much greater than that required for haematopoiesis. A finding of interest in their experiments is the observation that isoleucine given by mouth was much better utilised than that given by injection.

21 Hirwe, R. N. and Magar, N. G. (1951). Curr. Sci., **20**, 40.
22 Gaitonde, M K. and Sohonie, K. (1951). Curr. Sci. **20**, 217.
23 Roberts, E. A. H. and Wood, D. J. (1951). Curr. Sci., **20**, 151.
24 Lal, S. B. (1950). Ind. Jour. Med. Res., **38**, 131.
25 Baptist, N. G. (1951). Curr. Sci., **20**, 268.
26 Chandran, K. and Damodaran, M. (1951). Biochem. Jour., **49**, 393.

Ramachandran and Sarma [27] carried out investigations with hydrolysates of casein and fibrin and report that ionophoretic method of separation is a simple and inexpensive method for obtaining methionine from protein hydrolysates. They hope that this method will prove useful in the commercial preparation of amino acids from easily available and cheap protein sources, such as fish meal and slaughter house blood. Giri [28] advocates the use of circular paper chromatography for separation of amino acids from mixtures as a simple and expeditious method.

The results of investigations carried out in different laboratories under the auspices of the Vanaspati Research Advisory Committee have been briefly presented by Patwardhan.[29] Their findings may be summarised as follows: Linoleic acid content of hydrogenated oil samples was much lower than the corresponding raw oil samples. Phospholipids, tocopherol and cholesterol were present in raw oils but their quantity, excepting sterol was much reduced on hydrogenation. Nickel was present in the market samples of vanaspati to the extent of 0.02 p.p.m. to 7 p.p.m. Experiments with rats and monkeys failed to produce any toxic effects of nickel containing diets. Investigations on rats, using iso-oleic acid, which is present in appreciable amounts in hydrogenated fat, showed that this acid is utilised for metabolic processes. The digestibility of straight-hardened and blended hydrogenated oils of melting point between 37°C and 47°C were same. Hydrogenated products were less susceptible to spoilage from rancidity etc., than either the crude or the refined oil. Carotene was more stable in hydrogenated groundnut oil of M.P. 37°C and 41°C than in ghee, and crude or refined oil.

Sahasrabudhe and Subrahmanyan [30] found that the digestibility of hydrogenated oil was not affected by blending it with oils melting within the physiological range. Puntambekar and Ramachandra Rao [31] suggest addition of some chlorophyll to

27 Ramachandran, M. and Sarma, P. S. (1951). Curr. Sci., **20**, 39.

28 Giri, K. V. (1951). Curr. Sci., **20**, 295.

29 Patwardhan, V. N. (1951). Jour. Sci. Indus. Res., **10A**, 18.

30 Sahasrabudhe, M. R. and Subrahmanyan, V. (1951). *Ibid.*, **10B**. 119.

31 Puntambekar, S. V. and Ramachandra Rao P. (1951). Curr. Sci. **20**. 68.

hydrogenated fats so that if these are used for adulteration of ghee they can be easily detected, since heat or exposure to sun's rays cannot decolourise this pigment; further, it imparts a pleasant yellowish-green colour to the product.

According to Roy and Guha,[32] fresh green maize stalks, which are used as cattle fodder, contain 6.4 per cent of cane sugar and 1.2 per cent of invert sugar. They discuss the possibility of preparing some sort of 'gur' from these stalks.

Mineral Metabolism

Sadasivan[33] finds from his experiments on rats that zinc possesses lipotropic activity. When rats were fed a high fat low protein diet it produces a fatty degeneration of the liver; addition of zinc to the diet in comparatively high concentration caused a reduction both in the weight and fat content of rat livers. In further experiments, he[34] noted that zinc affects metabolism to a considerable extent. He fed rats on stock diet supplemented with zinc oxide at levels of 0.5 per cent and 1.0 per cent and found that there was increased faecal excretion of nitrogen and phosphorus and increased urinary excretion of nitrogen, uric acid and total creatinine.

Narayana Rao and Venkateswarlu[35] have developed a rapid and accurate method for the estimation of fluorine in natural waters by a modification of the thorium-alizarin mothod. They claim for this method an accuracy of 0.1 p.p.m. when the water contains fluorine to the extent of only 2.0 p.p.m. Venkataramanan, Krishnaswamy and Ramakrishnan[36] have found that a system of ion exchange resins comprising of a locally prepared cation-exchanger ('Avaram' resin) and an imported anion exchanger (Amberlite IR-4) is effective in removing fluorine from waters containing this element upto 5 p.p.m.

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32 Roy, D. K. and Guha, B. C. (1951). Science and Culture. **17**. 138

33 Sadasivan, V. (1951) Biochem. Jour., **48**, 527.

34 *Idem* (1951). *Ibid.*, **49**, 186.

35 Narayana Rao, D. and Venkateswarlu, P. (1951). Ind. Jour. Med. Res. **39**, 223.

36 Venkataramanan, K. Krishnaswamy, N. and Ramakrishnan, T. (1951) *Ibid.*, **39**, 211.

Dey and Friedmann [37] report that gingelly seeds (*Sesamum indicum*) contain large amounts of oxalate; hence, even though the seeds are very rich in calcium, nearly half to two-thirds of this element may be rendered unavailable because of the oxalate in the seed.

Other References

38 Ramachandran, L. K. and Sarma, P. S. (1951). 'Colorimetric determination of tyrosine,' Jour, Sci. Indus. Res., **10B**, 246.

39 Shanmugasundaram, E.R.B., Ranganathan, G. and Sarma, P. S. (1951). 'Studies on the inter-relationship among vitamins and amino-acids'. Curr. Sci., **20**, 122.

40 De, H. N. and Dutta, P. (Jr.). (1951). 'Studies on the biosynthesis of B vitamins-Part I.' Ind. Jour. Med Res,, **39**, 63.

41 De, H. N. and Roy, J. K. (1951). 'Studies on the biosynthesis of B, vitamins-Part II'. *Ibid.*, **39**, 73.

42 De, H. N. and Roy, J. K. (1951). 'Studies on the biosynthesis of B. vitamins—Part III.' *Ibid.*, **39**, 83.

43 De, S. P. and Mukherji, B, (1951). 'Microbiological assay of vitamin B_{12} and its role in evaluation of liver extract.' Ind. Med. Gaz., **86**, 403.

44 Bagchi, K. (1951). 'Oxalic acid and citric acid in ascorbic acid assay.' Jour. and Proc, Inst, Chem., **23**, 173.

37 Dey, B. B. and Friedmann, H. C. (1951) Curr. Sci. **20**. 182.

HUMAN PATHOLOGY

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The amount of work that has been carried out in the different aspects of human pathology in the year 1951, does not appear to be very encouraging either quantitatively or qualitatively. However, in the following pages an attempt has been made to review all the available papers published during that year. For convenience in reading, the papers have been classified under eight broad divisions as in the previous year.

I. NEW GROWTHS

Barman and Bose [1] have described a case of solitary plasmacytoma in a young girl of fifteen. The biopsy of the hard fusiform swelling in the middle of the right humerus showed the characteristic arrangement of round cells with little or no intercellular substance which resembled plasma cells. Bence-Jones protein was absent in the urine and biochemical investigations revealed no dysproteinaemia but there has been an increase in the alkaline phosphatase.

Sen and Banerjee [2] have described a case of Sacrococcygeal chordoma in a male child of three and has reviewed the condition. In the case reported, histological picture of the tumour was not typical of chordoma but appeared more like 'carcinomatoid chordoma.'

Merchant [3] has reported a splenic cyst in the case of a boy of seven years. It measured 15 cm. × 12 cm. × 12 cm. and the cut surface showed a large trabeculated cyst occupying nearly the whole of the spleen and containing watery brownish fluid. It was diagnosed as a haemorrhagic cyst of the spleen.

Gault and others [4] have submitted an excellent review of 549

1 Barman, M. L. and Bose, K. S. (1951). Indian Med. Forum, **2**, 339.

2 Sen, N. C. and Banerjee, S. K. (1951). Ind. Med. Gaz., **86**, 87.

3 Merchant, G. V. (1951), Ind. Jour. Med. Sci., **5**, 1.

4 Gault, E. W. Asirvadbam. M., Balasubrahmanyan, D'sena, G.W.L., Thomas, E. and Isaiah, P. (1951), Ind. Jour. Med. Sci., **5**, 297.

cases of carcinoma of the uterus diagnosed by biopsy. In that group there were 10 cases of adenocarcinoma of the corpus uteri, 14 cases of chorionepithelioma and 525 cases of carcinoma of the cervix uteri. Of the cases of carcinoma of the cervix, adenocarcinoma occurred in only 7 cases (1.3%) and adenoacanthoma was seen in one case. Others were epidermoid in type. Unusual forms were a scirrhus variety, a basal celled carcinoma, a form like adenoides cystic epithelioma and a small celled variety.

Patil [5] has described a case of an ovarian tumour which histologically has been considered to be one of adrenal-rest tumour and on clinical grounds, one of virilism. The patient suddenly died while in the hospital, and at autopsy, a big, firm and nodular tumour filling almost the whole of pelvis and incorporating the ovaries and the tubes was noticed. Some areas of the tumour were soft and others cystic. Histologically, the tumour appeared malignant and from the type and arrangement of the cells it was declared to be an adrenal-celltumour. Metastasis in the form of nodule having characteristics of the original tumour were found in the diaphragm and in one lymph node near the left kidney.

Balasubrahmanyan,[6] has presented the results of cytologic examination of 440 specimens. He has observed that cytologic diagnosis of cancer is a very valuable method in detecting carcinoma in various situations specially in the uterus.

II. DISEASES DUE TO BACTERIA

Cholera.—Ahuja and others [7] have presented an excellent note on the laboratory diagnosis of cholera. They recommend the use of a special preservative solution containing potassium chloride, boric acid, sodium hydroxide and common salt and direct plating on alkaline nutrient agar or Aronson's medium or a modified Wilson and Riley's solid medium. Preliminary enrichment has been recommended only in case of examination of stools of convalescents and contacts with the use of Read's modification of

5 Patil, H. B. (1951). Ind. Jour. Med. Gaz., **86** 154.

6 Balasubrahmanyan, M. (1951). Jour. Ind. Med. Assoc., **20** 347.

7 Ahuja, M. L., Krishnan, K. V. Pandit, S. R. and Venkatraman, K. V. (1951). Ind. Jour. Med. Res., **39**, 135.

Wilson and Blair's medium.

De and others [8] have presented part of their work on the general pathology of cholera toxin in the rabbit. The toxin was prepared from a recently isolated epidemic Inaba strain of *Vibrio cholerae*, and the rabbits died in about 2 hours after intraperitoneal injection of 1 c.c./Kg. of the killed suspension. At autopsy marked changes were observed in the kidneys, the cut surface of which showed a very pale cortex and a vivid purple medulla. Histologically it was seen that there was ischaemia of the cortical glomeruli and poor vascularity around the cortical tubules. It was thus observed that with one minimum lethal dose of the toxic preparation the blood laden with the toxin is more or less prevented from reaching the main cortical bed. On the other hand the congested medulla and the boundary zone had borne the brunt of the toxin diverted along with the blood from the cortex. In cases of human kidney of cases died of cholera the cut surface also presents a pale cortex and congested medulla and the appearance is strongly suggestive of the occurrence of the same shunting mechanism in such cases. In another paper, the same authors [9] have published a complete report of their study. Their work was with a view to test the concept that cholera in man is primarily an intoxication and that the organisms multiply in the lumen of the gut, die, undergo autolysis and liberate their endotoxin which acts locally and is also absorbed, producing systemic effects. They observed that the injection of the heat-killed organisms into the rabbit was followed by haemoconcentration and by fall of blood pressure. It has been suggested that the haemoconcentration is due to an alteration of permeability of the capillaries allowing passage of plasma-like fluid into the tissues. Such a change appears to be brought about by direct local action of the cholera toxin, and also by its remote specific action on the capillaries of the myocardium and of the inner coats of the small intestines. The authors have also shown that the toxin affects the vasculature and the parenchyma of the kidneys, leading to division

8 De, S. N., Sarkar, J. K. and Tribedi, B. P, (1951), Ind. Jour. Med. Sci., **39**, 326.

9 *Idem*, (1951), Jour. Path. and Bact., 63, 707.

of the toxin-laden blood from the cortex to the medulla. The vital cortical elements are thus protected from the effects of the toxin which, however, damages these parts of the nephrons situated in the medulla and juxta-medullary regions. As the majority of the glomeruli are rendered ischaemic, filtration of urine is diminished and further loss of body fluid by this route is prevented. The protective mechanism however fails when a very heavy dose of cholera toxin is injected. The authors have also discussed the significance of the experimental results in relation to the human disease. The chain of events in human cases of cholera, as suggested by authors, is as follows. The endotoxin of the vibrios, by local action on the capillaries of the intestinal mucose, increases the permeability causing an outpouring of plasma into the lumen of the gut. The toxin after being absorbed exerts a specific toxic effect on the capillaries. The loss of fluid from the circulation results in haemoconcentration and consequent fall of blood pressure. The shock-like manifestation is due to the direct effect of the toxin on the myocardium, where the specific action on the myocardiam capillaries gives rise to oedema and impairment of function. The toxin also acts specifically on the renal vessels and parenchyma as demonstrated in the rabbit.

Typhoid Fever.—Dhayagude and Banker [10] have attempted to type the strains of *Salmonella typhi* isolated from cases of typhoid fever in Bombay by means of Vi-bacteriophage. Among over 500 strains isolated during 1948-49, at least 10 of the Vi-' phage types described by Craigie and Felix [11] could be identified by the application of type-specific Vi-bacteriophage preparations. Of the cultures studied, 10.6% could not be assigned to any known type. The authors found that at least 8 Vi-'phage types are commonly prevalent in Bombay, which are, in order of frequency, A.E.$_1$, O. K. D$_1$. T. D$_6$ and J. The type A is very common being met with in 51.8% of the cultures tested. With the help of Vi-'phage types, it has been possible to distinguish at least 83 out

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10 Dhayagude, R. G, and Banker. D. D (1951). Ind. Jour. Med. Res., **39**. 1.

11 Craigie, J. and Felix, A. (1947). Lancet, i, 823.

breaks—39 in 1948 and 44 in 1949, of typhoid fever occurring in various localities and during different parts of the year.

Tuberculosis :—While studying chemotherapy of tuberculosis, Sirsi[12] has observed that aureomycin exhibits a marked effect, not only on the growth but also on the morphological and physiological characters of the tubercle bacilli. The diminished oxygen uptake in bacteriostatic concentration, the high percentage of degenerative forms seen at the end of 17 days and the increased lag phase in the growth of aureomycin-treated organisms indicate the profound alterations undergone by the organism. The author observed that the individual sensitivity of the micro-organism varied greatly with individual strains.

Leprosy.—Ghosh and others[13] have made a clinical and bacteriological study of nose and throat lesions in 80 cases of the lepromatous type of leprosy. Leprous changes have been found most frequently in the nose and least in the larynx. The pathological changes in the nose consist of infiltration, nodulation, atrophy, ulceration and perforation of the nasal septum. In the advanced cases destruction of the cartilaginous portion of the septum is frequently seen. There may be adhesions between the lateral wall and the septum, specially at the level of the inferior turbinate. The pathological changes in the pharynx and larynx are of the same nature, but usually less marked.

Relapsing Fever : —Agarwal[14] has studied 48 cases of tick-borne relapsing fever in 1949 amongst Indian troops in Kashmir. The diagnosis, in all cases, was established by demonstration of Spirochaetes in the blood. The author has suggested a new name *Spirochaeta crossi* to the causative strain of the Spirochaetes in view of the observations of Rao and Kalra[15,16] that the strain of Spirochaetes was transmitted by *Ornithodorus crossi*, and not by lice. In the cases studied, leucocytosis was found in 32% cases,

12 Sirsi, M. (1951). Jour. Ind. Med. Assoc., **20**, 280.

13 Ghosh, K. K, Dharmendra, and Dey, N. C. (1951), Ind. Med. Gaz., **86**, 400.

14 Agarwal, B. L. (1951), *Ibid*., **86**, 446.

15 Rao, K. N. A, and Kalra, S. L. (1949). Ind. Jour. Med. Res., **37**, 385.

16 *Idem* (1949). Curr. Sci., **18**, 249.

20% of the patients had excess of urobilinogen in the urine indicating early hepatic involvement.

Other Diseases.—Rananavre [17] has reported a case of Primary *Actinomycosis* of lungs. The conditions could be diagnosed only when biopsy of the tumour like mass which later appeared on the chest wall was made. The histological examination of the necrotic mass obtained after incision of the tumour revealed the ray fungus in the midst of chonic granulomatous tissue. Sen [18] has also reported a case of pulmonary *actinomycosis* which was diagnosed by microscopic examination of the sputum as well as 'granules' discharged through the sinuses in the chest wall. The infecting organism was identified to be *Actinomycosis bovis*. The case responded well to long continued penicillin therapy. Andleigh [19] has reported two interesting cases of mycotic infections, one of *actinomycosis* and the other of *rhinosporidiosis*, which could not be investigated in detail for want of facilities. The author feels that the fungus infections in India are more common than reported as there is lack of sufficient and efficient laboratory aids. He has stressed the need of establishment of one central, well equipped mycological laboratory in India.

III. DISEASES DUE TO VIRUS

Rabies.—D'Silva [20] has shown by periodic titration of virus content of a 20% emulsion of fixed-virus sheep brain in 50% neutral glycerine in distilled water stored at 0°C, that the infective titre remained more or less constant and the virus was found suitable for use as a local 'standard challenge' over a period of twenty-one months.

While studying the sites of election for Negri bodies in cases of rabies, Veeraraghavan [21] has observed that the mid-brain at the level of the oculomotor nucleus, was markedly superior to the hippocampus and the cerebellum as the site of election of Negri

17 Rananavre, M. N. (1951). Ind. Jour. Med. Sci., **5**, 63.
18 Sen, S. N. (1951). Ind. Med. Gaz., **86**, 101.
19 Andleigh, H. S. (1951). Ind. Jour. Med. Sci., **5**, 168.
20 D'Silva, C. B. (1950). Ind. Jour. Med. Res., **38**, 489.
21 Veeraraghavan, N. (1951). *Ibid.*, **39**, 261.

bodies. He also observed that Negri bodies were fewer and their size smaller in the brains of animals treated with 5% phenol vaccine but the treatment with a suspension of 5% normal sheep's brain in a 0.5% barbol-saline had no influence on the occurrence of Negri bodies. He confirms the views of other authors that hippocampus was not the site of election of Negri bodies and suggests that an examination of all the three areas of the brain, *e.g.*, hippocampus major, cerebellum and mid-brain may reduce the number of inconclusive results.

IV. DISEASES DUE TO HAEMOPARASITES

Blackwater Fever.—De and others [22] have attempted to find out any alteration in the morphology and in the fragility of erythrocytes or any serological change which might throw some light on the mechanism of haemolysis in a case of Blackwater fever. They found no evidence of any red cell change which could account for the haemolysis. They however demonstrated the presence of cold agglutinin in the serum which supported the idea that an (auto) antigen-antibody reaction is concerned in the mechanism of haemolysis.

Leishmeniasis —The histological changes in the spleen in different stages of Kala-azar have been described by Sen Gupta and Bhattacharyya. [23] They have shown that definite signs of hypersplenism develop in the chronic stage of Kala-azar and hypersplenism is very marked in the very advanced stages of the disease. Persistence of hypersplenic state after the cure of Kala-azar may lead to chronic splenomegaly with anemia as a late sequel of Kala-azar. The authors are of the opinion that the presence of marked hypersplenism in advanged cases of Kala-azar is probably one of the factors that interferes with the specific treatment of Kala-azar and leads to apparent drug resistance.

Sen Gupta and Das Gupta [24] have described a case in which intradermal injection of leptomonads from a culture of *Leishmania*

22 De, S. N., Sen Gupta, K. P., Bhattacharyya, K. and Konar, N. R. (1951). Jour. Ind. Med. Assoc., **21**, 95.

23 Sen Gupta, P. C. and Bhattacharyya, B. (1951). *Ibid.*, **21**, 1.

24 Sen Gupta, P. C. and Das Gupta, C. R. (1951). Ind. Med. Gaz., **86**, 6.

donovani was followed by the development of cutaneous nodules at the sites of inoculation. With a view to producing leucopaenia by artificial induction of Kala-azar in a case of chronic myeloid leukaemia, several intra dermal inoculations of a culture of *Leishmania donovani* were made. After about 4 months the patient noticed small papules over the forearm at the sites of the intradermal injections. The papules increased in size to form painless nodules, freely movable over the underlying tissues. The epidermis over the nodules developing on the earlier inoculation showed thinning but no ulceratain supervened. On examination of a smear from one of the nodules showing thinning of the epidermis, typical L-D bodies were found and the culture in N.N.N. medium showed many leptomonads. Till the time of recording the case, generalized visceral disease had not developed.

Dutta[25] has reported a case of post Kala-azar dermal leishmanisis with ulceration. The patient was diagnosed and treated as a case of Kala-azar before. About 3 years later there was appearance of depigmented patches on the face, trunk and extremities. Sometime afterwards ulceration occurred on the affected areas on the nose, cheek and temporal region. Scrapings from the ulcers showed L-D bodies. Sternal and Spleen punctures did not reveal L-D bodies. Kahn test was positive. The lesions disappeared after a course of Stibatin.

V. DISEASES DUE TO INTESTINAL PARASITES

Amoebiasis.—Tribedi and Roy [26] have described an unusual type of amoebic liver abscess which could not be diagnosed at life-time even after laparotomy. The patient later died of shock from rupture of the abscess and autopsy revealed a large solitary abscess cavity, 3″ in diameter, filled with chocolate coloured necrotic material in the left lobe of the liver, destroying almost the whole of the substance of the left lobe leaving a thin shell. The abscess opened into the pericardial sac through a rent in the diaphragm. The lungs and the pleural cavities were free. Amoebic ulcers were found in the caecum. The case is of interest on account of the fact that rupture of an amoebic liver abscess into the pericardium and

25 Dutta, S. C. (1951). Ind. Med. Gaz., **86**, 354.

26 Tribedi, B. P. and Roy, A. R. (1951). Ind. Jour. Med. Sci., **5**, 242.

without involvement of either lungs and or pleura is distinctly rare.

Chakravarty[27] has reported 6 cases of pulmonary amoebiasis collected during a period of two years. In four cases the diagnosis was confirmed by demonstration of *Entamoeba histolytica* in the sputum.

Bhoumik[28] has reported a case of amoebic infection of the female genital organs. There were multiple ulcers on the vaginal walls and the cervix, which had irregular overhanging margins. The whole of the vaginal mucous membrane was oedematous. Swabs from the ulcers showed vegetative forms of *Entamoeba histolytica*. The case was successfully treated with emetine and enteroquinol.

Other Diseases.—Ghorpure[29] has made studies on helminthic antigens. He attempted to find out the possibility of an antigenic substance being elaborated by *Ascaris* in the fluid medium. 10-20 adult worms with active movements were kept in 0.6% sterile saline for 9-11 days. The solution was evaporated and the material suspended in sterile distilled water. This mixture, supposed to contain the antigen was brought in contact with serum of the patient in capillary tubes and a positive test was noted by a milky ring at the contact of the two fluids. Dilution of the serum from 1 in 5 to 1 in 160 were used. The significant positive test was observed with the sera of parasitised hosts with 1 in 80 and rarely in 1 in 160 dilution. In control sera, occasionally, positive reactions were observed but not above 1 in 20 dilution. From this reaction it has been presumed that the worms during the extra corporal life were capable of elaborating a substance or substances antigenic in nature as determined by *in vitro* tests. Ghosh[30] has reported a case *ascaris* in the common bile duct with the symptoms of cholelithiasis and cholceystitis. No stones were present nor was there any obstructive symptoms. There was however deposit of biliary muds and the gall bladder showed evidence of chronic inflammation.

27 Chakravarty, A. (1951). Jour. Ind. Med. Assoc., **20**, 399.

28 Bhoumik, A. (1951), Ind. Med. Gaz., **86**, 355.

29 Ghorpure, P. V. (1951). Ind. Jour. Med. Sci., **5**, 329.

30 Ghosh, S. M. (1951), Jour. Ind. Med. Assoc. **20**, 333.

Sharma and Bhatia [31] have made certain observations on anemia of *ancylostomiasis*. Of the 135 cases of anemia studied they found that in nearly 80% cases the anemia was of an iron-deficiency type, but in the other 20% cases the anemia was of other forms. They also came across a few cases in which during the course of iron therapy the anemia changed its character from Microcytic hypochromic type to Macrocytic hyperchromic type. They observed that there was no relationship between the number of worms expelled after treatment and the degree of anemia. In some cases in which only few worms were expelled the anemia was quite severe, and in some where large number of worms were expelled, the anemia was of mild type. They also observed that abnormalities in gastric secretion as determined by fractional test meal analysis, do not play any contributory role in these cases where anemia was severe in the presence of few worms. The authors concluded that the extent of anemia was either due to the duration of the infestation or to different virulence of the worms or to a more susceptible nature of the host. They are of the opinion that anemia in ancylostomiasis is probably due to the toxic action of some substance elaborated by the worms which prevents the utilisation of the iron and that dewormification in the beginning of the treatment is essential for effective iron therapy.

Hamid [32] has reported a case of *hydatid cyst* of 1½ years duration and of the size of a coconut in the neck of a young woman. The cyst contained five daughter cysts of various sizes.

Reddy [33] has reported a case of cerebral *cysticercosis* which was spotted only at the time of exploratory operation. The patient was admitted for severe headache and giddiness and no organic defect was seen on various investigations.

VI. DEFICIENCY DISEASES

Epidemic Dropsy:—Bhatia and Malaviya [34] has submitted a preliminary report on experimental epidemic dropsy. The experi-

31 Sharma, Miss and Bhatia, B. B. (1951), Ind. Jour. Med. Sci., **5**, 454.

32 Hamid, A. (1951), Jour. Ind. Med. Assoc., **20**, 260.

33 Reddy, D. J. (1951), Ind. Med. Gaz., **86**, 14.

34 Bhatia, B. B. and Malaviya, B. B. (1951), Ind. Jour. Med. Sci., **5**, 542.

ment was confined to volunteers from the Central Jail, Lucknow. One of the volunteers was used as a control and was given one ounce of pure mustard oil daily with his usual well balanced diet and the other five were fed on mustard oil adulterated with 10% *Argemone mexicana* oil. In all the five test cases epidemic dropsy like syndrome could be produced. Clinical picture in them were however somewhat different from that seen in epidemics. For instance, during the period of experiment no cardiovascular or visual signs were noticed. Except in one case no skin lesions were apparent. The gastro-intestinal and general toxaemic symptoms were far more pronounced in the experimental series than is observed in the naturally occurring disease. The workers also succeeded in producing in rhesus monkeys an epidemic dropsy like syndrome, exactly similar to that produced in the human volunteers. Rabbits and rats however did not develop any signs when fed with *Argemone mexicana* oil. Further work on the subject is in progress and will be published by the author later.

Mitra [35] has published his preliminary observations on feeding experiments with argemone oil. One set of guinea pigs was fed with pure argemone oil and the other set with argemone oil freed from toxic alkaloids. He observed that in the argemone oil group nearly all the organs showed intense congestion and the heart showed dilatation of the vessels beneath the pericardium with normal muscle fibres. There was no marked change in the kidneys. In the other group, the organs did not show much congestion but effect on the heart was same as in the previous group. His observations are thus in accord with the findings of De and Chatterji [36] and of Shanks and De [37] as seen in cases of epidemic dropsy in man.

Chakravarty and Chaudhuri [38] have experimentally produced Epidemic dropsy in monkeys by administering argemone oil either by injestion with normal diet or by stomach tube with rice diet. Argemone oil, when applied to the skin, produced local erythema and cutaneous lesions and changes in the internal organs showing

35 Mitra, H. N. (1951), Jour. Ind. Med. Assoc., **20**, 315.

36 De, M. N. and Chatterjee, K. D. (1935), Ind. Med Gaz., **70**, 489.

37 Shanks, G. and De, M. N. (1931), Ind. Jour. Med. Res. **19**, 469.

38 Chakravarty, N.K. and Chaudhuri, R. N. (1951). Ind. Med. Gaz **86**, 392.

that the oil is absorbed from intact healthy skin. The animals died of toxic effects of argemone oil, and the histological appearance of the tissues simulated that of human epidemic dropsy.

Goel [39] has studied an outbreak of epidemic dropsy in a Railway Division, caused through the consumption of a particular consignment of mustard oil found adulterated with argemone oil. The oedematous type predominated greatly and the incidence of neuritic type was less than 2%. Lal[40] has investigated few outbreaks of epidemic dropsy in Bihar and observed that the disease was entirely confined to the middle class people and occurred more amongst the Bengalis than in other communities. He found that the cause was due to consumption of mustard oil containing argemone oil. Stopping the supply of such adulterated mustard oil stopped the incidence of fresh cases.

Other Diseases :—Gopalan and Patwardhan [41] have presented certain observations about a syndrome of malnutrition in children named by them "Nutritional oedema syndrome." They have described in detail the changes in liver and skin as seen in biopsies before and after treatment. Changes in one of the autopsy Pancreas have also been described. Of the biochemical changes, they observed that the plasma proteins were initially very low which after treatment with high protein diet rose to the normal level. They found that the fall in plasma proteins involved both the albumin and the globulin fractions, though the fall in plasma albumin was more pronounced. They also found that the plasma lipase and plasma esterase which were low initially also rose considerably after high protein therapy.

Mazumdar and Mukherji [42] have reported 3 cases of spontaneous hypoglycaemia occurring repeatedly in nutritional oedema. In two cases the fasting blood sugar was found low and after sugar meal the blood sugar level came to the original level in the

39 Goel, L. N. (1951), Jour. Ind. Med. Assoc., **21,** 4.

40 Lal, S. B. (1951), Ind. Med. Gaz., **86,** 64.

41 Gopalan, C. and Patwardhan, V. N. (1951), Ind. Jour. Med. Sci., **5,** 312.

42 Mazumdar, D. C. and Mukherji, K. L. (1951), Jour. Ind. Med. Assoc. **20,** 361.

scheduled time, showing the defect to be in nutrition in respect to available carbohydrate and protein intake or absorption. In one case the blood sugar curve maintained a steady rise even after 7 hours, apparently due to defective absorption or deranged storage mechanism in the liver.

VII. MISCELLANEOUS DISORDERS

Ghosh [43] has studied 50 cases of *Tropical Eosinophilia* within a period of 4 years. Leucocytosis, was present in almost all the cases, the highest count being 25,000 c.mm. in the series. The highest eosinophil count was 67%.

Andleigh [44] has reported a case of Primary cutaneous *Blastomycosis*, hitherto unrecognised in India. The lesion consisted of an ulcer 6″×3″ in size, on the thigh with small pustules at a number of places particularly at the margin. The pus contained yeast-like cells with refractile doubly contoured cell wall, morphologically resembling *Blastomyces dermatidis*. On culturing on Sabouraud's medium, whitish glabrous and moist colonies were seen after 4 days and the growth showed small broad mycelia which were thick walled and closely septate. A small piece of the tissue from the lesion was examined histologically. There was marked hyperkeratosis and dyskeratosis with occasional formation of large squamous pearls. There were several abscesses in the epidermis within the stratum corneum, with preponderance of neutrophil cells. In some of them were seen rounded cyst like bodies about 15-20 microns in diameter. These had a thick double contoured faintly acidophilic wall and contained a little irregular lump of basophilic (nuclear) material within the cyst cavity. The stratum malphigi showed marked proliferation of cells and the formation of irregularly inter-connected branching retecones. In some areas there was a loss of cell polarity and frequency of mitosis simulating a malignant change. The presence of dermal abscesses with a neutrophilic exudate, as well as the cystic organisms found in them suggested a cutaneous lesion of

43 Ghosh, R. K. (1951), Patna J. Med., **25**, 213.

44 Andleigh, H. S. (1951). Ind. Jour. Med. Sci., **5**, 59.

North American Blastomycosis. The intra-dermal test with Blastomycin was positive.

Mathur and Wahi [45] have analysed clinically 690 cases of congestive heart failure to determine the existence of cardiac cirrhosis and to formulate the criteria for such a diagnosis. The essential requirements considered by them are a palpable hard liver with or without granularity, a palpable spleen, ascites, jaundice and the repeated filling up of the abdomen, inspite of digitalisation, mercuric diuretic and paracentesis, out of proportion to the generalised oedema over the legs, feet and the body. The authors also examined 61 specimens of liver obtained at autopsy and biopsy and observed that the essential histological changes were dilatation of sinusoids with cloudy swelling of liver cells and haemorrhages. In more advanced cases there was central necrosis. Cases of longer duration showed fibrosis, which may be central, periportal, patchy, perilobular or extensive hepatic fibrosis with destruction of architectural pattern. In view of these findings the authors have suggested that the term cardiac cirrhosis as taken to mean a set pattern of fibrosis resultant on congestive heart failure be dropped and instead the condition be called 'hepatic fibrosis of cardiac decompensation.'

Wig [46] has submitted an analysis of 69 cases of pulmonary suppuration of which 28 were diagnosed as lung abscess, 22 were proved to have bronchiectasis and 19 were considered to be suffering from the cystic diseases of the lung. Of the cases of lung abscess, the aetiological factor in about 46% cases was found to be heavy dental sepsis though in about 80% cases marked dental sepsis along with teeth encrusted with tartar were seen. In the series of bronchiectasis a foreign body was the cause in 2 cases and 3 cases were secondary to tuberculosis. 9 of the cases had dental sepsis and 6 had congested throat. The cystic conditions fell into the group of cystic bronchiectasis.

Chatterjee and Basu Roy [47] have reported a case of spon-

45 Mathur, K. S. and Wahi, P. N. (1951), Jour. Ind. Med. Sci., **5**, 151.

46 Wig, K. L. (1951), *Ibid.*, **5**, 529.

47 Chatterjee, P K. and Basu Roy, B. (1951), Jour. Ind. Med. Assoc., **20**, 374.

taneous hypoglycaemia in a man of 55 years. As there was no sign of liver damage, Addison's disease or hyperinsulinism, the case was considered as one of Idiopathic Spontaneous Hypoglycaemia. The patient never had any symptom of hypoglycaemia with the blood sugar as low as 37 mg. per 100 c.c.

An extensive study on *toxaemias of pregnancy* has been made by Mukherjee [48] who has presented his results of investigation into the causes of oedema in pre-eclampsia. The relation between oedema and the factors like hypertension, albuminuria, oliguria, plasma volume, plasma proteins and capillary permeability have been studied, and the author has concluded that none of these physical factors can by themselves give rise to oedema in pregnancy toxaemia. In the presence of electrolytic inequilibrium, these factors may play an auxiliary role. The author has found no evidence of damage to the capillary endothelium caused by the widely believed toxin of toxaemia of pregnancy.

Gour [49] has reported a case of *Myotonia acquisita* in a soldier. Biopsy of the muscles showed that the individual fibres were markedly hypertrophied, sarcolemmal nuclei were increased in number, the transverse striations could not be clearly seen and the muscle fibres showed vacuolation.

Chatterjee and others [50] have studied six fatal cases of acute hepatic failure in infective hepatitis and have recorded their pathological findings. Possible explanation of the occurrence of severe necrosis of liver in infective hepatitis has also been discussed.

Veliath and Srinivasachar [51] have studied 121 cases of portal cirrhosis of the liver with reference to their clinical history and macroscopic and microscopic appearance of liver. 57 of these cases showed a histological pattern of fatty infiltration with varying degrees of fibrosis and were classified as 'Deficiency Cirrhosis,' the fatty infiltration being the result of deficiency in food of lipotropic factors like vitamin B, choline and proteins containing

48 Mukherjee, C. (1951), Jour. Ind. Med. Assoc., **20,** 389.

49 Gour, K. N. (1951), Jour. Ind. Med. Gaz., **86,** 99.

50 Chatterjee, P. K., Basu Roy, B. and Lahiry, D. (1951), Jour. Ind. Med. Assoc., **20,** 127.

51 Veliath, G. D. and Srinivasachar, S. (1951), *Ibid.*, **20,** 271.

essential amino-acid methionine. 67 cases were classified as "Post secrotic cirrhosis" of unknown aetiology. The authors are of opinion that alcohol plays no significant role in the etiology of cirrhosis in the Madras Province.

Pirzada and Kapur [52] have reported a case, a Punjabi male child of $3\frac{3}{4}$ years, suggestive of *Cooley's anaemia*. In addition to many positive features, the case showed characteristic radiological changes in the bone, in the form of enlargement of the diploae, thinning of outer tables and presence of radial needle-like striations in frontal, parietal and occipital bones. Other skull bones showed osteosclerosis and long bones showed rarefaction, widening of the medullary canal and thinning of the cortex.

Konar [53] has described a case of Addisonian pernicious anemia with sub acute combined degeneration of the spinal cord in a Hindu male aged 53 years. The patient had all the charateristic features, *e.g.* middle age, macrocytic anaemia, full haemoglobinization of red cells, megaloblastic marrow, histamin-fast achlorhydria, sub acute combined degeneration of the cord and satisfactory response to liver extract and vitamin-B_{12}.

VIII. CLINICAL PATHOLOGY

Rao [54] has made studies on the Prothrombin time. He observed that the normal prothrombin time determined by use of Russel's viper venom in dilution of 1 in 10,000 as the source of thromboplastin is 21 seconds with a standard deviation of 1.5 seconds. The author has discussed the variables affecting the determination of the prothrombin time and has described experiments to ascertain the influence of these variables.

Chaudhuri and others [55] have determined plasma and blood volumes by Evans Blue method together with total proteins and haemoglobin in 50 healthy Indians. The average values they found for Plasma and Blood volumes are 47.7 c.c./kg. and

52 Pirzada, M. A. and Kapur, P. N. (1951), Ind. Med. Gaz., **86**, 150.

53 Konar, N. R. (1951), *Ibid.*, **86**, 237.

54 Rao, B. D. F. (1950), Ind. Jour. Med. Res. **38**, 419.

55 Chaudhuri, R. N., Chakravarti, H. and Dutta, B. N. (1951), *Ibid.*, **39**, 237.

83.1 c.c./kg. respectively. The total circulating protein and haemoglobin found by them are 168.5 ± 32.5 g. and 580.3 ± 146.2 g. respectively.

Mitra [56] has found natural anti-typhoid anti-para 'A' agglutinins in the blood upto a titre of 1/125 in a fair number of population of Calcutta. In almost no case the titre of Para 'B' agglutinins had risen above 1/50. He found that both 'H' and 'O' agglutinins are almost equally distributed in case of Salm. typhi, and the females exhibit a slight preponderance of both 'H' and 'O' agglutinins.

Goyle and Luthra,[57] while studying the subject of laboratory diagnosis of enteric fevers considered that a level of 1 : 250 for typhoid 'H' agglutinin and 1 in 125 for typhoid 'O' agglutinin as fairly diagnostic of typhoid fever in uninoculated individuals. Similarly, a level of 1 in 50 for Para A (O) and 1 in 125 for Para A (H) can be considered as diagnostic. In the inoculated, 'H' agglutinins should be ignored and only a high titre of 'O', preferably above 1 in 500 should be taken into account. A rising titre is of greater value than any single preconceived diagnostic titre.

Singh [58] has made an extensive study on agglutination reaction in enteric infections and in other diseases and has very carefully tabulated the results. He has detected 'O' agglutinins for Salm. typhi in quite a large number of normal sera and has observed that there was no significant stimulation of 'O' agglutinins for Salm. typhi in diseases like malaria, pneumonia, tuberculosis, amoebic hepatitis, anaemia, P.U.O. and other respiratory catarrhal conditions. 'O' agglutinins for other members of the typhoid-para-typhod group were also affected but very little by these diseases. Frequency and concentration of 'H' agglutinins for Salm. typhi were however increased during these diseases. Typhus fever caused maximum stimulation. He also observed that titre of 'H' and/or 'O' agglutinins for Salm. typhi below 1 : 125 was not significant in the diagnosis of typhoid fever.

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56 Mitra, S. N. (1951), **Ind. Med. Forum.**, **2**, 342.

57 Goyle, A. N. and Luthra, P. N. (1951), **Ind. Jour. Med. Sci.**, **5**, 659.

58 Singh, Balbir (1951), **Jour. Ind. Med. Assoc.**, **20**, 248.

Wahi [59] has submitted a preliminary report on Meinicke's clarification reaction done in 793 sera and 8 cerebro-spinal fluids together with Wassermann's and Kahn's tests. In 801 cases there were 187 disagreements which have been analysed. The author found that Melnike's clarification reaction showed agreement in 76.2% cases when done together with Wassermann's and Kahn's tests. Compared with Wassermann's and Kahn's separately, it has been shown that the reaction agrees more with Khan's test than the Wassermann's test. When the Wassermann test is compared with Kahn test the agreement occurs in 84.1% cases. It has therefore been shown that this simple test will at least give 76.2 to 80% of correct results. The author recommends this test as a daily screening test where Wassermann test is being done once a week to check the doubtful results.

Singh [60] has given a review of the progress made in differentiating false positive serological reactions for syphilis from true reactions. Incidence of these reactions in normal and apparently non-syphilitic individuals and in certain diseases has been mentioned. The author has observed that in 51.56% cases of leprosy (both lepromatous and neural), W.R. and/or Kahn test was positive or doubtful. The W. R. was positive/doubtful in 40.5% and the Kahn test was positive/doubtful in 42.1% cases. In case of malaria, the author found positive W. R. and/or Kahn test in 38.6% of 122 cases studied. The corrected positive rate for malaria was 27.3% as 11.3% of the hospital population not suffering from malaria showed positive W. R./Kahn tests. The author has also studied serological tests in 16 cases of Eosinophilia. The combination of a positive Wassermann with a negative or doubtful Kahn test was a characteristic feature of these reactions. Of the 42 cases examined after small-pox vaccination, 14.3% showed positive/doubtful W. R. and/or Kahn test. These reactions were observed only in those who showed non-immune or accelerated reaction, and disappeared usually in 2 months time but persisted up to 4 months in some cases. Lobar pneumonia showed a higher

59 Wahi, P. N. (1951), Ind. Jour. Med. Sci., **5**, 234.

60 Singh, Balbir (1951), Ind. Jour. Med. Sci., **5**, 318.

percentage of positive or doubtful results than the rest of the hospital population. No conclusive evidence of false positive reactions in pulmonary tuberculosis was noticed by the author.

Chakravarti [61] has made a comparative study of the methods of estimation of plasma proteins. He found that there was good agreement between results obtained by Copper Sulphate-Specific gravity method and by Kjeldahl's method, the mean difference being only + 0.11 g.%. As regards the albumin fraction, there was also good agreement between the Biuret method and the Kjeldahl method, the mean difference being + 0.06 g.%. In 75 normal male individuals of the age group 25-45 years, the average plasma proteins were found to be: Total protein—7.1 g.%, Albumin—4.5 g.%, Globulin—2.6 g.% and albumin-globulin ratio—1.8. The same author [62] has also studied the plasma protein patterns in 47 untreated cases of leprosy—29 of neural type and 13 lepromatous. In neuro-macular type, changes like hyper-proteinaemia due to rise in the globulin fraction were found in many cases, and the degree of such changes varied directly with the extent of the lesion. In tuberculoid variety, the changes were least marked. In lepromatous group, the worker found considerable rises in total proteins and mostly in the globulin fraction. Albumin was normal or slightly depressed.

Chakravarti and Mitra [63] have estimated the different N-constituents of the blood and determined the urea clearance of 100 normal persons of Uttar Pradesh. They found the values as: Blood urea — 20-50 mg./100 c.c., N.P.N. 18-45 mg./100 c.c., proteins 5.44-8.1 g./100 c.c., urea clearance C_m 74-120% and C_s 45-120%. They observed that about 15% of the normal cases have high blood urea and N.P.N. value, and suggest that value of blood urea upto 50 mg./100 c.c., should be considered normal for clinical purposes. They are of opinion that in normal cases, a combined information of the different N-constituents and of urea clearance gives a better biochemical assessment than is available from the data of single ingredients.

61 Chakravarti, H. (1951), Ind. Jour. Med. Res., **39**, 99.

62 Chakravarti, H. (1951), Ind. Med. Gaz., **86**, 196.

63 Chakravarti, M. G. and Mitra, S. (1951), *Ibid.*, **86**, 343.

Lokre [64] has estimated serum sodium and potassium of 25 young healthy persons of Central India and found the average values as 336.84 mg./100 c.c. and 18.858 mg. 100 c.c. respectively.

Mukherjee [65] has studied plasma alkaline phosphatase in 93 cases of normal pregnancy and has found that during last three months of the pregnancy the phosphatase values are higher. He also observed that plasma phosphatase in pre-eclampsia and eclampsia is abnormally high as is also in accidental haemorrhage associated with shock. He found that labour increases the phosphatase level of the plasma which is marked in prolonged labour and in presence of toxaemia.

Nadkarni and Broker [66] have found that the Indian male-toad *Bufo melanostictus* which is readily available is very suitable for the diagnostic test of pregnancy and for diagnosis of some other conditions where chorionic gonadotropin is excreted in the human urine. They think that this species is more suitable than the more commonly found *Rana tigrina*, inasmuch as unlike the latter, the toad shows no seasonal variation in responding to the pregnancy hormone. The authors consider the dorsal lymph sac route to be better than the others hitherto reported. For concentrating the urine samples, the acetone precipitation method was found by them to be most satisfactory.

Pereira [67] while studying the reticulocytes in the new born, observed that the average count on the first day is 3.4%. After gradually decreasing from day to day, the value on the seventh day, as found by him, is 0.34%. The persistence of higher percentage may be taken as a fair index of abnormal haemopoiesis and can help in the diagnosis of erythroblastosis, when Rh factor tests are not feasible.

Modi [68] has studied Volhard's water dilution and concentration test and Maclean and Wesselow's urea concentration test in a group of 50 cases with definite evidence of renal damage and with

64 Lokre, R. J. (1951), *Ibid.*, **86**, 45.

65 Mukherjee, C. (1951), Jour. Ind. Med. Assoc., 21, Nov.

66 Nadkarni, S. M. and Broker, R. S. (1951), Jour. Ind. Med. Sci., **5**, 228.

67 Pereira, A. F. (1951), *Ibid.*, **5**, 639.

68 Modi, B. G. (1951), *Ibid.*, **5**, 719.

no renal damage. It was observed that in conjunction with the clinical evidence these tests gave a useful picture of the kidney damage by the degree of deviation from the normal. These tests are found to be of definite value in the treatment and prognosis, the concentrating and diluting capacity helping in the adjustment of the fluid balance in the treatment and serving as a rough index of recovery.

Saha and Das[69] have submitted their observations on biochemical findings of the blood in 49 cases of cholera. They found the average specific gravity of blood and plasma as 1066 and 1037 respectively, the average plasma protein as 13.1 g. per 100 c.c., serum sodium-294.4 mg./100 c.c. serum potassium-25.5 mg./100 c.c. blood chloride-286.1 mg./100 c.c. (as chloride ion), plasma chloride-353.3 mgm. of chloride ion/100 c.c., plasma inorganic phosphate-7.1 mg./100 c.c. and alkali reserve-15.8 m.eq. 1. Their findings indicate that there is a loss of water, sodium chloride and bicarbonates from the body associated with an increase of inorganic phosphorus. There is also a relative excess of sodium loss over that of the chloride.

Sirsi[70] has studied the toxicity of commonly used sputum digestants, *viz.*, sulphuric acid, antiformin and sodium hydroxide and has compared with that of sulphonated castor oil and trisodium phosphate. He has observed that trisodium phosphate is the least toxic of all the digestants. He recommends that sputum and other contaminated materials should be collected in 10% trisodium phosphate while sending the specimens for cultural investigation of tubercle bacilli.

Dogra[71] has presented an analysis of 1,217 samples of endometrial biopsy from women of under privileged class. He has noted a fairly high incidence of tuberculous endometritis (5.55%) and a very high incidence of chronic endometritis (53.92%). Malignancy has been recorded in 1.41% cases. There is however no information about the clinical condition of the patients studied

69 Saha, H. and Das, A. (1951), Jour. Ind. Med. Assoc., **20**, 427.

70 Sirsi, M. (1951), Ind. Med. Gaz., **86**, 10.

71 Dogra, J. R. (1951), *Ibid.*, **86**, 145.

and as such it is not possible to ascertain whether the tuberculous endometritis were from general tuberculous cases or were primary condition.

Swamy and Subramaniam [72] did some experiments with a view to evaluate blood-stained cerebro-spinal fluid as to its chemical, and cytological contents. They observed that in case of blood-stained C.S.F., the increase in protein due to admixture of blood is at the rate of 15 mg. per cent for every 10,000 R.B.C. per c.mm. of the fluid, and the chloride and sugar contents are not significantly affected. They have suggested a formula by which the corrected protein level of a blood stained C. S. F. can be calculated. The Nonne-Apelt test, according to the workers, is of no significance when the red cell count exceeds 10,000 per c.mm.

Mittal and Chakravarti [73] have studied blood and urine chemistry and haemocytology in acute febrile infections. They observed that all infective processes lead to varying degree of anaemia. High E.S.R. values during the febrile infection does not appear to depend on the amount of plasma fibrinogen. A relative hyper-proteinaemia has been observed which is due to the dehydration accompanying pyrexia. The globulin fraction is the one which is found increased in different infections. They also found an increase of blood urea which is due to an accelerated N-catabolism and in most cases, and does not imply a renal injury. Blood creatinine values are affected to a less extent but the values of urine creatinine are high and vary proportionately with the severity of infective toxaemia. Urea clearance in a number of cases is found to be improved, but in severely toxaemic cases is impaired.

72 Swamy, T. V. and Subramaniam, K. N. A. (1951). *Ibid.*, **86**, 243.

73 Mittal, V. N. and Chakravarti, M. G. (1951), Ind. Med. Gaz., **86**, 245.

DAIRY SCIENCE

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Inspite of the magnitude and economic importance of dairy industry in India, research work in dairy science has not yet received sufficient attention. This is partly due to a lack of appreciation of the significance of dairy research to the development of the industry. The main cause would, however, appear to be the general backwardness of the industry itself and the inadequate efforts made by Governmental as well as other agencies to improve the position. It is also unfortunate that while scientific research in general has made remarkable progress in recent years under the aegis of the Ministry of Scientific Research, a similar record of progress in agricultural, veterinary and dairy sciences, which are of such vital importance to the nation is not evident. Even in the draft Five Year Plan [1] of the National Planning Commission very little attention has been devoted to the development of dairying and the organisation of dairy research in the country. Recently, the Government of India have re-organised the Indian Council of Agricultural Research [2] constituting a Board of Research and a Board of Extension, and it is to be hoped that the Agricultural Research Board will be of assistance in giving some substantial impetus to the progress of dairy research in the country.

Research work in dairy science in this country has been carried out chiefly at the Indian Dairy Research Institute (Government of India) Bangalore, and partly under the research schemes sponsored by the Indian Council of Agricultural Research at different centres. Certain allied aspects have also been investigated at a few agricultural and veterinary institutions. The present position of dairy research and education in India has been discussed by Iya [3] while Nanda [4] has reviewed

1 Draft Five Year Plan of the Planning Commission, 1951.

2 (1951), Indian Dairyman, **3**, 26.

3 Iya, K. K. (1951). Indian Dairyman. **3**, 28.

4 Nanda, P. N. (1950). Indian Farming, **11**, 221.

the progress of work done under the scheme of regionalisation of animal husbandry research sponsored by the Indian Council of Agricultural Research. A Bibliography of Dairy literature of South-east Aisa [5] for the period 1945-49 has been published by the Indian Dairy Science Association in collaboration with the South Asia Co-operation Office of the Unesco.

Animal Management

The breeding of cattle for increased milk production in the country has been approached from two directions (i) the development of pure and high yielding milch breeds by selective breeding and (ii) grading up of the general types of cattle using bulls of high milk yielding quality. In connection with the former work accurate descriptive records of the characteristics of known fixed breeds of milking animals is of vital importance. The definition of characteristics of *Kangayam*, *Khillari* and *Tharparkar* cattle and *Nili* and *Surti* buffaloes is given in a bulletin recently published by the Indian Council of Agricultural Research.[6] The introduction of artificial insemination technique has been considered to offer the only practical solution for grading up the indigenous stock in the face of the acute shortage of proven bulls in the country and considerable amount of field and laboratory work is in progress at several centres.[7,8] Sampath Kumaran [9] has published a comprehensive account of the theory and methods of the technique of artificial insemination and animal production. The use of India ink in the microscopic examination of semen has been described by Krishna Rao.[10]

The determination of the body weight of farm animals is a valuable aid in the feeding and management of cattle and in the absence of special weighing machines the estimation of body

5 Bibliography of Publications in Dairy Science of South and South Asia, for 1945-49 (1951) Indian J. Dairy Sci., **4**, No. 1,

6 I. C. A. R. Bull. No. 47 (1950), Manager of Publications, Delhi.

7 Indian Farming—Special No. 1951, I. V. R. I. Diamond Jubilee.

8 I. C. A. R. Annual Report, 1950-51, Manager of Publications, Delhi.

9 Sampath Kumaran, J. D. (1952). Artificial Insemination and Animal Production, Mission Press. Jubbulpore.

10 Krishna Rao C. (1951). Curr. Sci., **20**, 211.

weights by indirect methods, such as measurements of heartgirth, length, etc. of the animal, is of great practical value to the farmer. Bhandari *et al* [11] found that it was possible to determine the body weights of lactating and dry (non-pregnant) she-buffaloes by means of the formulae—2387.60 + 27.14 G + 24.55 L and 2123.73 + 26.35 G + 21.50 L, respectively, where G and L represent the girth and length of the animal in inches. In regard to dry animals which are pregnant, the formula—1934.48 + 20.52 G + 25.90 L was found suitable for calculating the body weights.

An account of the research activities of the Indian Veterinary Research Institute on various aspects of veterinary science and animal management are presented in a special number of Indian Farming[7] published on the occasion of the Dimond Jubilee celebrations of the Institute. Roy *et al* [12] have made some observations on the significance of ascorbic acid in the reproductive physiology of farm animals. They have pointed out that a deficiency of ascorbic acid presumably resulted in a decreased secretion of progesterone by the endocrine glands and caused premature or still births in cows. The beneficial influence of feeding vitamin C for restoring fertility in animals has been explained on this basis. The antibacterial properties of the active principle "Allicin," present in garlic extract, have been studied by Mukherjee and Nilakantan [13] who have reported it to be active against all Gram-positive as well as Gram-negative pathogens *in vitro*. An important contribution to the problem of controlling rinderpest in bovines in India has been made by the use of lapinised rinderpest vaccine (Nakamura III).[14] Ray[15] reported *Hyalomma aegyptium* Neum. as an intermediate host of the protozoan, *Theileria*

11 Bhandari, N. L., Puttaswamy, C., Narayan, D. and Rangaswamy M. C. (1951), Indian J. Dairy Sci., **4**, 106.

12 Roy, A., Luktuke, S. N. and Bhanacharya, P. (1950), Ind. J. Vet. Sci., **20**, 199.

13 Mukherjee, R. and Nilakantan, P. R. (1951), Science and Culture, **17**, 171.

14 Datta, S., Sitharaman, C. and Rajagopalan, V. R. (1951), Indian Vet. J. **28**, 1.

15 Ray, H. N., (1950), Trans. Roy. Soc. Trop. Med. and Hyg., **44**, 93.

annulata, which was capable of transmitting the disease to susceptible cattle through at least four generations.

The problems of livestock breeding and management in relation to dairy farming have been discussed by Warner.[16] The research work done in connection with the feeding of cattle has been reviewed separately in the chapter on Animal Nutrition.

Milk

The composition of milk of Indian milch animals has been the subject of considerable investigation during the year. A number of communications have appeared on the use of the refractive constant (derived from the specific gravity and refractive index) and fluorescence of milk for the detection of adulteration of milk.[17,18] A large number of samples of milk of cows and buffaloes, collected from different parts of India, have been analysed for their specific gravity and refractive index. Murthy *et al*[19] examined the fatty acid composition of butterfat from milk of different quarters of the udder but did not find any significant differences in the R. M., Polenske and B. R. values.

In regard to the chemical constitutents of milk, the thiamine, riboflavin and nicotinic acid contents of milk of Indian cows, buffaloes, goats and sheep have been reported by Venkateswara Rao and Basu.[20]

The average values for these vitamins in ug/ml in milk of different species are given below :—.

	Cow (Average for different breeds)	Buffalo (Murah)	Goats (Surti)	Sheep (Kathiawar)
Thiamine	0.49	0.50	0.43	0.97
Riboflavin	1.50	1.07	0.75	1.85
Nicotinic acid	0.81	0.83	1.30	1.42

16 Warner, J. N. (1951), Dairying in India, Macmillan & Co., Calcutta.

17 Ramakrishnan, C. V. and Banerjee, B. N. (1951), Science and Culture, **17**, 176.

18 Venkatasubramanian, T. A. and Ramakrishnan, C. V. (1951) Science and Culture, **17**, 260.

19 Murthy, G. K., Lalitha, K. R. and Dastur, N. N. (1951), Indian J. Dairy Sci., **4**, 129.

20 Venkateswara Rao, R. and Basu, K. P. (1951). Ind. J. Dairy Sci, **4**, 21.

Thiamine and riboflavin content of cow and buffalo milks were found to show some correlation with the seasons of the year while there was little seasonal correlation shown by niacin. Sreenivasa Murthy[21] has assayed riboflavin in milk and milk products by adopting microbiological assay procedure. This worker has claimed that Lactobacillus plantarum—89 gave more satisfactory results as a test organism for the microbiological assy of riboflavin in milk than *L. casei* ε, the standard test organism.

Kalyanakrishnan *et al*,[22] have continued their studies on vitamin A in milk. In their study on the seasonal variation of carotene and vitamin A in milk of cows and buffaloes, the authors found that the carotene content of milk in the case of cows and vitamin A potency of milk in the cases of both cows and buffaloes increased during the seasons when more carotene was available in the form of green fodder. Cow milk fat is slightly richer in total vitamin A potency than buffalo milk fat, but owing to the higher fat content of the latter, buffalo milk would be richer than cow milk.

The tributyrinase activity of the milk of different mammals has been studied by Kannan and Basu,[23] who found a definite influence of the oestrus cycle on the activity of this enzyme and no effect of the seasons. Goat and sheep milk were low in tributyrinase activity. The enzyme was inactivated by heating milk to 140°F for 15 minutes. They have disproved, on the basis of their findings, the persistent belief that rancid milk is yielded by cows in late lactation. These workers have also continued their investigations on the phosphatase activity in milk at different temperatures. The milk phosphatase was not inactivatad between 10° and 35°C. They have studied the rate of inactivation between 45° and 75°C and have reported the values for the energy of activation of the hydrolysis of sodium phenyl phosphate at pH 10 and pH 5.4 by the phosphatases in the milk of different species of mammals.[24]

21 Sreenivasa Murthy, V. (1951), Microbiological Assay of Riboflavin in milk and milk products M. Sc., Thesis, University of Bombay.

22 Kalyanakrishnan, M. G., Paul, T. M., Ananthakrishnan, C. P. and Sen, K. C. (1951), Ind. J. Dairy Sci., **4**, 143.

23 Kannan, A. and Basu, K. P. (1951), Indian J. Dairy Sci., **4**, 63.

24 *Idem*, (1951), *Ibid.*, **4**, 8.

Continuing their studies on the microflora of Indian milk the group of workers at the Indian Dairy Research Institute have reported further results regarding the biochemical characteristics of coliform bacteria and the spore-forming aerobes occurring in milk.[25,26,27,28] Interesting data on the rates of growth, lactose utilisation, gas production and protein breakdown have been provided in respect of different species of coliform bacteria.[26,27] It was reported that the methylene blue reduction time of milk showed a closer relationship to coliform content than to the total plate count thus emphasizing the importane of methylene blue reduction test in the quality control of market milk.[27] Amongst the spore-forming organisms studied,[28] *Bacillus coagulens* and *B. albolactis* were found to cause considerable lactose breakdown while *B. cereus* and one strain of *B. subtilis* converted nearly 60 to 94 per cent of the total protein nitrogen of milk into non-protein nitrogen in about 5 days at 37°C. The vegetative cells of these organisms were killed by exposure to 98°C for 30 minutes but the spores of *B. subtilis* and *B. albolactis* required heat-treatment at 115°C for 20 minutes for their destruction. Spores of *B. cereus* had to be exposed to 115°C for 30 minutes or 120°C for 10 minutes for their complete destruction. Khare[29] studied the heat-resistance of some species of aerobic spore-forming bacteria in milk and the critical time required for the germination of the spores into vegetative cells. Based on this information the author claims to have developed a method for the preservation of milk. Aibara[30] has investigated the growth and

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25 Gopalakrishna, B. N. (1951), Biochemical Studies on Coliform Bacteria in Milk, M. Sc., Thesis, University of Bombay.

26. Gopalakrishna, B. N. and Iya, K. K. (1951), Indian J. Dairy Sci., **4**, 1.

27 *Idem*, (1951), *Ibid.*, **4**, 103,

28 Varma, K., Laxminarayana, H. and Iya, K. K. (1951), Indian J. Dairy Sci., **4**, 151.

29 Khare, N. P. (1951). Identifications and study of spore-forming bacteria obtained from market milk in Poona and a method for their elimination in separated and whole milk with a view to preserve it M. Sc. Thesis. University of Bombay.

30 Aibara, F. D. (1951). J. Univ. Bombay, **19**, 66.

heat-resistance of some strains of *Streptococcus lactis* and *S. thermophilus* isolated from milk. Nambudripad and Iya [31] have reported further data regarding the bactericidal efficiency of hydrogen peroxide in respect of some more organisms of dairy importance. It will be interesting to know how far these results could be used for the preservation of milk and the possible implications of adopting such a process in commercial practice. Some preliminary observations on the bactericidal action of various metals in milk have been made by Bharucha and Verma.[32]

The technology of milk processing in relation to storage and transport has been studied by Gunnery *et al.*[33] These workers found that simple cooling of milk to 40°, 50° or 60°F. was only half as effective as heat-treatment (holder pasteurisation) combined with cooling in increasing the keeping quality of milk at room temperature. In their opinion heat-treatment of milk at 170°F. for 10 minutes followed by cooling to 72° ± 2°F. with the help of circulating water was the most effective method of processing not only in the case of fresh raw milk but also of raw milk exposed to atmospheric temperature for about 6 hours. Radakrishnan *et al* [34] have recommended 170°F. as the most suitable temperature for processing milk and pointed out that there was no appreciable improvement in the keeping quality of milk by heating it to higher temperature even upto 210°F.

The various aspects of the nutritive value of milk in relation to processing were among the subjects discussed at a symposium[35] on 'processing food-stuffs and their effect on nutritive value."

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31 Nambudripad, V. K. N. and Iya, K. K. (1951), Indian J. Dairy Sci., **4**, 38.

32 Bharucha, F. D, and Verma, H. C. (1951). Indian J. Dairy Sci., **4**, 33.

33 Gunnery, K. S., Pal, R. N. and Ray, S. C. (1951), Indian J. Dairy Sci., **4**, 53.

34 Radhakrishnan, G. B. Srinivasan, M. R. and Ray, S. C. (1951). Indian J. Dairy Sci., **4**, 81.

35 Proc. Soc. Biol. Chem. India (1950), **9**. 15.

The influence of fat on the utilization of lactose in milk by rats and rabbits was studied by Banerjee.[36]

The introduction of a programme for the chemical and bacteriological control of the quality of market milk in India and standardisation of methods to be used for the purpose have received some attention. Dastur [37] and Iya [38] have discussed the present position of the legal standards for milk and milk products in different parts of the country and stressed the need for prescribing precise and uniform standards of quality and their strict enforcement. The Indian Council of Agricultural Research have described [39] standard methods for the chemical and bacteriological examination of milk and milk products other than ghee. An iodometric method for the routine estimation of proteins in milk has been described by Puri and Singh.[40,41]

Milk Products :—Further data regarding the changes in the chemical composition of milk during its souring and conversion into dahi over a period ranging upto 7 days have been reported by Khambatta and Dastur.[42] The total nitrogen content remained unchanged while non-protein nitrogen, dialysable nitrogen and ammonia nitrogen increased and protein nitrogen decreased. The changes were observed to be most marked during the first 48 hours and with raw milk samples. According to Sreenivasamurthy [21] there was no appreciable alteration in the riboflavin content of dahi prepared by using mixed starter cultures usually employed for making dahi.

Krishnaswamy [43] studied the microbial changes in *desi* and

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36 Banerjee, S. (1951), Proc. Soc. Expt. Biol. Med. **77**, 585.

37 Dastur Noshir, N. (1951), Indian Dairyman, **3**, 63 and 76.

38 Iya, K. K. (1951), Indian Dairyman, **2**, 146.

39 I C A R Bulletin No. 70, 1951, Manager of Publications, Delhi.

40 Pritam Singh (1951). Studies in Physico-Chemical changes in milk during dahi formation and new methods for the estimation of major constituents of milk. M. Sc. Thesis. University of Punjab.

41 Puri, B. R. and Pritam Singh (1951) Indian J. Dairy Sci., **4**, 135.

42 Khambatta, J. G. and Dastur, N. N. (1951). Indian J. Dairy Sci., **4**, 73.

43 Krishnaswamy, M. A. (1951) J. Univ. Bombay, **19**, 21.

creamery butter during storage and Mukherjee[44,45] has carried out investigations on the influence of oxygen concentration and the enzyme systems involved on the spoilage of fats. The detection of adulteration of ghee with hydrogenated vegetable fats (Vanaspati) continues to present a challenging problem to dairy scientists. The compulsory colourisation of hydrogenated fats with chlorophyll so that the admixture of the coloured material with ghee could easily be detected has been suggested by Puntambekar and Ramachandra Rao.[46] The possibilities of using ion-exchange resins for the elimination of free fatty acids in vegetable oils and ghee have been examined by Venkitasubramanian and De [47] and this method of renovating the fats has been claimed to be superior to the common practice of neutralisation of the acids with alkali. The comparative digestibilities and growth-promoting values of ghee, vegetable oils and hydrogenated fats have been reported by Bhale Rao *et al.*[48,49]

Kannan and Basu [50] reported that during the ripening of cheese, phosphatase activity was subject to periodic fluctuations before it ultimately ceased. Lipase active at pH 8.6 was feeble in the beginning, gradually increased upto 50 days and then declined. Lipase active at pH 5.4 was more active at all stages of ripening. The protease activity changed in character, optimum pH changing from 8.9 to 5.4 as ripening progressed and decreased with time and the effective enzyme was found to be a peptidase. Buffalo milk cheese ripened slowly with a corresponding decrease in protease activity. The riboflavin content of cheddar cheese was reported by Sreenivasamurthy [21] to range from 3.5 to 5.1 ug./g on the basis of dry weight.

44 Mukherjee, S. (1950), J. Indian Chem. Soc., **27**, 699.

45 Mukherjee, S, (1951), Archives Biochem. & Biophysics, **33**, 364.

46 Puntambekar, S. V. and Ramachandra Rao (1951), Current Sci. **20**, 68.

47 Venkitasubramanian, T. A. and De, S. S, (1951), Science and Culture **17**, 180.

48 Bhale Rao, V. R., Venkatappiah, D. and Anantakrishnan, C.P., (1950), Indian J. Vet Sci., **20**, 151

49 Paul, T. M., Bhale Rao, V. R and Anantakrishnan, C. P. (1951), Indian J. Vet. Sci., **21**, 1.

50 Kannan, A. and Basu, K. P. (1951), Indian J. Dairy Sci. **4**, 115.

ANIMAL NUTRITION

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The published reports on research in animal nutrition continued to be fairly extensive and varied during the year under review. It is observed from a perusal of the review on animal nutrition published last year that some of the papers published in the latter part of 1949 were not dealt with probably because, the reviewer could not get them in time. These papers have, therefore, been included in the present review.

According to Kehar and Deb Goswami [1] leaves of *Bauhima variegatta* known in Uttar Pradesh as *Kachnar* is a common source of feed for cattle in winter months when other fodders become scarce. They have, therefore, carried out a study to evaluate the nutritive value of the leaf. To start with, detailed analysis has been done to get an idea of the gross distribution of the nutrients as well as of tannin substances. The leaf is found to be rich in protein and is comparable in this respect with Berseem and Oats grown in some parts of the country. It has a rather wide Ca/P ratio due to a high calcium and relatively low phosphorus content. The digestibility trial conducted on goats shows that *Kachnar* leaves can supply per 100 lb. of raw material, 3.58 lb. Digestible Protein (D. P.) and 14.3 lb. Starch Equivalent (S. E.) These values indicate fairly high nutritive quality for the leaf which is further supported by the positive balance maintained by the animals for N, Ca and P throughout the experimental period. The authors have not, however, mentioned in their paper how far the data collected by feeding goats would be true for cattle.

In the course of their systematic studies on herbage plant, Dabadghao, Gandhi and Wadha [2] have been able to select out *Phalaris minor* Retz as a new promising winter fodder grass. The authors have recorded their experience on the different agro-

1 Kehar, N. D. and Deb Goswami, M. N. (1951), Science and Culture, **16**, 476.

2 Dabadghao, P. M., Gandhi, R. T. and Wadha, N. D. (1951), *Ibid.*, **17**, 113.

nomical aspects in the Production of *Phalaris minor*, and have given its yield to be 175 to 200 maunds per acre. The analysis carried out at different stages of growth has shown that the grass is fairly rich in protein-19.04%, when young, and 13.93% at flowering stage. The grass is readily consumed by dairy cattle, and is mentioned to be 80% palatable relatively to Berseem.

Talapatra and Deb Goswami [3] and Talapatra [4,5,6,7] have communicated a series of papers on the nutritive value of the indigenous grasses of Assam. In the first paper detailed investigation has been carried out to study the utilization of aquatic grasses, Dal (*Hymenachne amplexicaulis* Nees) and Uridal (*Oryza sativa* var. Fatua), in the dietary of cattle. It has been observed that although cattle do not relish them as green fodders, these grasses are fairly rich in protein and phosphorus, but poor in calcium. The palatability of the grasses is greatly increased on conversion into hay. Besides, feeding as hay saves the animal from worm infestation which they otherwise get when the grasses are consumed as such. The D. P. and S. E. values per 100 lb. are 2.65 lb. and 31.2 lb. respectively for Dal hay as compared to 3 49 lb. and 28.1 lb. for Uridal hay. The feeding of these grasses whether as green, hay or silage does not ensure calcium equilibrium in animals. In the second paper is reported the use of the acid-producing pasture grass Ulu (*Imperata arundinacea* Cyrill) as a cattle feed. Feeding of animals on Ulu which is the predominant species among the pasture grasses in Assam has been found to be the cause for excretion of acid urine. The urinary acidity increases as the animals are fed with the grass of advancing maturity. The induction of acidity under different conditions of feeding the grass does not seem to affect the calcium and phosphorus metabolism of young and adult animals in the same manner. In the young, the acid condition helps in the retention of calcium and

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3 Talapatra, S. K. and Deb Goswami, M. N. (1949), Indian J. Vet. Sci. **19**, 19.

4 Talapatra, S. K. (1950), *Ibid.*, **20**, 183.

5 *Idem* *Ibid.*, **20**, 229.

6 *Idem* *Ibid.*, **20**, 241.

7 *Idem* *Ibid.*, **20**, 257.

phosphorus whereas in the old, positive retention is uncertain. The utilisation of semi-aquatic grasses, *viz.* Arali (*Leersia hexandra*) and Nal (*Arundo donax* Linn) has been the subject matter for the third paper. Arali grass in flower contains per 100 lb. of green feed, 0.82 lb. D. P. and 11.9 lb. S. E. When turned into hay at this stage by the tripod system, very little loss occurs on the digestible portion of the constituent nutrients; 100 lb. of the hay contains 2.0 lbs. and 23.9 lbs. of D. P. and S. E. respectively. The other grass, Nal, is not relished by cattle. This grass, however, throws, shoots (in the early part of May) which are not only relished by cattle, but also have fairly high nutritive value. In the fourth paper has been reported the nutritive value of two of the hill grasses *viz.* Dhus (*Eraianthus longsetosus* Andress ex Bth) and Kharika (*Microtegium ciliatum* A. Camus). The early-cut Dhus at 4 ft. height contains about 8% crude protein, its late-cut tops show almost the similar composition. The other variety, Kharika, is relatively inferior and contains about 5% crude protein at its prime stage. The nutritive value per 100 lbs. of green has been assessed as 1.04 lbs. D. P. and 10.5 lbs. S. E. for the early-cut Dhus and 1.40 lbs. D. P. and 15.4 lbs. S. E. for the late-cut Dhus tops. The mature bullocks seem to digest the 'tops' more efficiently than the young animals. Kharika grass is relatively inferior to Dhus in nutritive value. Though they appear to be poor in calcium and phosphorus, both the grasses provide enough of these minerals to give a positive balance when fed *ad lib.* In the last paper of this series the various methods of hay making under varying conditions have been described. It has been observed that in hay making by tripod system, the loss of digestible protein is much more in monsoon (with 70" rainfall and over 70 relative humidity) than in fair weather conditions obtained in October-November. The loss in protein can be significantly reduced when hay making is carried out in the shed. Irrespective of weather conditions, the energy value (S.E.) of hay is not influenced by the method of drying. According to the author, hay made from indigenous grasses in all seasons by any one of the methods studied, can meet the maintenance requirement of adult animals.

Srivastava, Mukherjee and Shrikhande[8] have carried out an investigation to study the trend of yield and nutrient make-up in Berseem when allowed to grow to maturity (i) without taking any cut, (ii) following the first cut 9 weeks after sowing, (iii) following the second cut 7 weeks after the 1st, (iv) following the third cut 6 weeks after the 2nd and (v) following the fourth cut 4 weeks after the 3rd. The results obtained suggest that intermittent cutting helps in the tillering which not only gives a large yield but also a richer herbage.

Das Gupta, Srivastava and Saxena[9] have carried out an experiment to assess the quantitative supply of digestible nutrients, and feeding value for milk production of tops of sugarcane Co 312. The tops used for digestion test gave on dry basis 3.2, 2.4, 58.3 and 66.8 per cent of digestible protein, ether extract, total carbohydrates and total digestible nutrients respectively. The feeding of sugarcane tops maintained the normal trend of milk production even when oil-cake supplement necessary with wheat straw was reduced by 50%.

In connection with the systematic investigation on famine ration, Kehar and Sahai[10] have studied the utilisation of *Jaman* seed as a feed for livestock. The chemical analysis of the seed showed its protein content comparable to those in well known grains like barley, maize, oats, etc. When the seed was fed to Kumani bullocks to replace 75% of their concentrate requirement, the animals not only readily consumed the material but made a remarkable gain in live weight. The metabolism studies showed that all experimental animals during *Jaman* seed feeding regime could remain in positive balance for N, Ca and P. According to the statement given in the paper, 100 lb. of the seed contains, on dry matter basis, 5.82 lb., 45.1 lb. and 45.53 lb. of D.P., S.E. and (total digestible nutrients) T. D. N. respectively.

Zubairy and Ayyar[11] have reported the results of alkali

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8 Srivastava, B. P., Mukherjee, S. K. and Shrikhande (1950), *Ibid.*, **20**, 169.

9 Das Gupta, N. C., Srivastava, S. P. and Saxena, J. S., (1949), *Ibid.*, **21**, 291.

10 Kehar, N. D. and Sahai, K. (1949), *Ibid.*, **21**, 37.

11 Zubairy, A. W. and Ayyar, N. K. (1949), Ind. J. Vet. Sci., 21, 47.

treatment of Bhurra grass (*Saccharum munja*). Bhurra grass in mature stage is not consumed by cattle. When it is treated with 1.5% solution of caustic soda, the resultant product becomes palatable, and animals consume on an average of 1.4 lbs. per 100 lb. of live weight along with a suitable amount of concentrate. In a ration made up of alkali treated Bhurra grass plus a small amount of oil cake, the animals have not only maintained their live weight but also remained in positive balance for N, Ca and P. The treated grass is found to be an energy-rich roughage containing 58.8% T. D. N.

In continuation of their earlier work on the evaluation of pre-requisites which will permit the use of well known formula for calculating the biological value of a protein, Mukherjee and Kehar [12] and Kehar and Mukherjee [13] have carried out investigations to assess the biological value of the proteins of wheat, paddy and oat straws in combination with some common oilcakes. The results obtained have been summarised in the following self-explanatory table :—

Ration				Biological value per cent		Statistical significance of difference between pairs
Roughage	Oilcake	Protein level %	S E. intake lb.* per 1000 lb. B. W.	Mean	Standard error	
A Wheat straw	Groundnut	8.5	4.1	41.5	0.7	A, B = Highly significant
B Oat straw	,,	9.0	4.1	63.1	4.1	
C Wheat straw	Colza	9.3	4.2	48.3	2.2	C, D = Highly significant
D Paddy straw	,,	8.7	5.6	62.1	0.6	
E Oat straw	,,	7.6	4.3	73.9	4.9	C, E = Highly significant

Some of the other interesting points observed from these studies are, (i) at a given protein level true digestibility co-efficients

12 Mukherjee, R. and Kehar, N. D. (1949), *Ibid.*, **21**, 275.

13 Kehar, N. D. and Mukherjee, R. (1949), *Ibid.*, **21**, 283.

* Calculated on the basis of the 0.73 power of the body weight.

of the proteins of two rations are almost the same or vary within a narrow range, (ii) the estimate of the biological value is not measurably affected by the type or breed of cattle used, and (iii) between the two species, *viz.* cow and sheep, however, the estimate varies, and the indications are that cattle can utilise absorbed nitrogen little more efficiently than sheep for maintenance.

Mukherjee and Mitchell [14] have studied the basal energy and nitrogen metabolism in calves in hyperthyroidism induced by thyroprotein administration. They observe that in hyperthyroidism, the basal metabolic rate and the minimum endogenous urinary nitrogen increase, showing thereby that both the basal expenditure of energy and the endogenous catabolism of nitrogen are elevated. Their results, according to the authors, give an idea of the TDN and DCP (Digestible crude protein) cost involved in the extra milk to be produced due the induction by iodinated casein ; the cost, over the normal, may be more than 100% for the former and about 50% for the latter.

Chanda, Clapham, McNaught and Owen[15,16] have shown that chromium sesquioxide (Cr_2O_3) can be used with considerable accuracy as a marker in faeces to measure the digestibility of carotene by goats and cows. The authors consider that the chromium ratio method of determining digestibility of carotene gives more reliable results with fewer animals for a longer time than with more animals for a shorter time. By adopting their new method of determining digestibility, these authors have carried out further investigation to study the digestibility of carotene by the cow and the goat as affected by the subcutaneous injection of thyroxine (10 mg/cow/or goat 1 day) and thiouracil (20 mg/cow or goat/day). The results show that following a depletion, if carotene is restituted in the diet, reappearance of faecal carotene is made much earlier in animals treated with thiouracil than those treated with thyroxine. The administration

14 Mukherjee, R. and Mitchell, H. H. (1951), J. Ani. Sci., **10**, 149.

15 Chanda, R., Clapham, H. M., McNaught, M.L. and Owen, E.C. (1951), J. Agri. Sci., **41**, 179.

16 Chanda, R., Clapham, H. M., McNaught, M.L. and Owen, E.C. (1951) Biochem. J., **50**, 95.

of thyroxine markedly increases the digestibility of carotene whereas thiouracil acts in the reversed manner. The increase due to thyroxine, however, is more in the cows than in the goats while the decrease due to thiouracil is more pronounced in the goats than in the cows.

Kalyanakrishnan, Paul, Anantakrishnan and Sen[17,18] have carried out two series of investigations on feeding vitamin-A supplement; one, in lactating cows and buffaloes, and the other, in young calves. They observe that supplementation of shark liver oil to lactating cows and buffaloes kept on low carotene diet has no effect on milk yield, fat content of milk and general conditions of the animals The supplementation, however, increases the vitamin-A in butterfat from 13 to 51 I.U./gm. and from 14 to 43 I.U./gm. for cows and buffaloes respectively. When a massive dose of 100,000 I U. day is administered, cows respond better than buffaloes as indicated by the maximum individual value of 68 I.U gm. of butterfat in the former as compared to 53 I.U./gm. of butterfat in the latter. The supplementation with shark liver oil seems to decrease the carotene content in butterfat of both the species. The feeding of young calves (4-day old) of three different breeds, *viz.* Gir, Sindhi and Cross-bred with a supplement of shark liver oil to supply 6000 I.U./day, in the first month, and 7500 I.U./day, in the second month seems to have resulted in slight increase in weight, and height which, however, is found statistically not significant.

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17 Kalyanakrishnan, M. G., Paul, T.M., Anantakrishnan, C. P. and Sen, K. C., (1951) Indian J. Dairy Sci., **4**, 16.

18 Kalyanakrishnan, M. G., Paul, T. M., Anantakrishnan, C. P. and Sen, K. C. (1951), *Ibid.*, **4**, 45.

MICROBIOLOGY INCLUDING ANTIBIOTICS

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The literature pertaining to microbiology and antibiotics is summarised under the following heads: (i) General and metabolic studies, (ii) Soil Microbiology, (iii) Applied Microbiology and industrial fermentation and (iv) Antibiotics.

General and Metabolic Studies

A method of selective absorption of bacterial cells on a mixture of kaolin and charcoal was adopted by Krishnamurti and Soman [1] wherein it was found that, while *B. subtilis* and *B. coli* were adsorbed, *Staphylococci* were not adsorbed. Kaushal [2] has described a simple device for spraying mould spores for surface cultures.

Soil Microbiology

Attempts have been made in the reviewer's laboratory to improve the existing methods for the isolation of actinomycetes in pure cultures.[3] Norri's medium was found to be most suitable for the isolation of soil actinomycetes. Better results were however obtained with certain dyestuffs.

Nandi and co-workers [4] have reported that inoculation of legume seeds before sowing, improved the legume crop in the fields and concluded that the above process should be utilised as a precaution against the absence of effective strains of bacteria in soil and its competition with ineffective strains.

Bharucha *et al* [5] observed from the autocatalytic nature of the curve for oxidation of ammonia to nitrite that the nitrosification curve showed a steeper course for fertile soil of *Amaranthus* plots

1 Krishnamurti, K. and Soman, S. V. (1951), Proc. Ind. Acad. Sci. **34**, 81.

2 Kaushal, R. (1951), Curr. Sci., **20**, 58.

3 Ann. Report (1951), Bose Institute, Calcutta.

4 Nandi, P. N., Sen, S. P. and Mukherjee, S. K. (1951), Ann. Report (Bose Institute), 1951

Bharucha, F. R., Dubash, P. J. and Sheriar, K. C (1951), Curr. Sci., **20**, 241.

and required a shorter duration to reach the peak than the infertile soil from *Eleusine* plots and hence the oxidation in the former was faster than that in the latter. The "rate constant" K varied also with the nature of the soil. They observed that on the basis of the differences in the rate constants it was possible to grade various types of soils. Bharucha and Sheriar [6] demonstrated that there is a time lag during the oxidation of ammonia to nitrous acid in soil. In this case they studied the rate of nitrosification in soils isolated from the root regions of *Amaranthus spinosus*, *Eleusine indica* and *Astercanthus longifolia*.

Applied Microbiology and Industrial Fermentation

Basu and Bhattacharya [7] made a comparative study of fungi growing on a wide variety of lignified fibres They found that two species of *Chaetomium*, one of *Penicillium*, and four of *Aspergillus* were frequently encountered on vegetable fibres with 100 per cent R. H. at temp. 25°-35°C. Fungi of the *Dematiaceae* family, known to attack vegetable fibres vigorously when exposed outdoors, were suppressed under the above conditions probably due to competition with other fungi.

Sarojini [8] observed that greater protection to seedling emergence in wilt infested soils was obtained by the addition of micro nutrient solutions of B, Zn, and Mn especially at certain concentration levels. The survival and persistence of *Fusarium udum* was conditioned by the presence of micro nutrient elements in the soil, Zn being responsible for the rapid disappearance of the fungus from soil.

Sadasivan [9] made an extensive review of the role of trace elements in controlling the soil-borne fungal diseases of plants. He dealt with the researches done on the control of the three species of *Fusarium* causing wilt of cotton, Cajanus and paddy.

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6 Bharucha, F. R. and Sheriar, K. C. (1951), Science and Culture, **17**, 267.

7 Basu, S. N and Bhattacharya, J P. (1951), J. Sci. Ind. Res. **10**B, 91.

8 Sarojini, T. S. (1951), Proc. Ind. Acad. Sci. **33**, 49.

9 Sadasivan, T. S. (1951), Proc Ind. Acad. Sci. **33**, 135.

Mehrotra [10] studied the effects of 4 growth hormones (2,4-dichlorophenoxy acetic acid, 1-naphthyl acetic acid, 3-indolyl acetic acid and *r*-3 indolyl butyric acid) on the following *Phytophthore* species—*P. cryptogea*, *P. parasitica*, *P. arecae* and *P. meadii*. The hormones in most cases even in the smallest concentrations retarded the growth of Phytophthoras and they were definitely toxic at higher concentrations. The sexuality was never found to be induced in the presence of these substances.

Damodaran and Subramanian [11] investigated the ability of several strains of *A. suboxydans*, *B. xylinum* and a strain of *Acetobacter* for their ability to oxidize sorbitol to sorbose and optimum conditions required for a reproducible performance of *A. suboxydams* were established Improvements effected in the fermentation were to use oxygen in place of air, and to utilize rice bran or millet extract in place of yeast extract. Several pounds of sorbitol were fermented and as a result of oxidation for 48 hours, 95-97 % sorbose was produced.

Pavgi *et al* [12] studied the polygalacturonase activity of three strains of *Aspergilli* (*A. luchuensis*, *A. flavus* and *A. niger*) and observed that the maximum amounts of enzymes were elaborated after 4 days of growth at pH 5.0 using both synthetic liquid media and wheat bran. The wheat bran was found to be a better substrate and aqueous glycerine was very satisfactory for the extraction of the enzyme from the growth medium. A partially purified polygalacturonase preparation was obtained by the method of precipitation with ammonium sulphate At pH 4-5 the activity of the enzyme on citrus pectin was found to be optimum and rapid hydrolysis took place during the first 12-24 hours.

Ramachandran and Osmani [13] reported that the production of itaconic acid by *A. terreus* (strains NRRL 255 and 1960) took place with the following optimum concentrations of the inorganic

10 Mehrotra, B. S. (1951), Curr. Sci. **20**, 131.

11 Damodaran, M. and Subramanian, S. S. (1951), J. Sci. Ind. Res. **10B**, 7.

12 Pavgi, M. S., Pithawala, H. R., Savur, G. R. and Sreenivasan, A. (1951), Proc. Ind. Acad. Sci. **34**, 33.

13 Ramachandran, K. and Osmani, Z. H. (1951), Curr. Sci. **20**, 325.

salts *e.g.* NH_4NO_3,-0.1 % KH_2PO_4-0.05 % $MgSO_4$-0.05 % with or without traces of KCl. They used dextrose as the source of carbon and corn steep liquor was omitted from the media.

Ghosh [14] studied the effect of environmental factors controlling the growth of fungal flora damaging the rice grains during storage. 117 isolates were distributed mainly amomg 7 genera *viz. Aspergillus*, *Penicillium*, *Mucor*, *Fusarium*, *Cladosporium*, *Alternaria* and *Oidium*. *Aspergillus* spp. were most abundant (90%) in the samples tested. Ghosh [15] further reported about the nutritional requirements of a group of rice inhabiting fungi selected on the basis of their high dextrinase, amylase, protease, and lipase producing activities. The carbon sources included various mono- and di-saccharides and organic acids; nitrogen sources were peptone, rice glutelin, sodium nitrate and ammonium compounds. Various aminoacids and vitamins were also used both as sources of nutrition and of growth stimulation. Of the aminoacids and proteins dl-alaline and rice glutelin were found to increase the diastatic activity of most of the fungi.

Antibiotics

The antibiotic activity of different groups of Cryptogams have been studied in the reviewer's Laboratory, while workers at the Indian Institute of Science, Bangalore are making important contributions to the study of antibacterial substances from higher plants. The survey of antibiotic-producing fungi and actinomycetes occurring in the soils of India undertaken at Microbiology Section, Bose Institute, have been continued in the year under review and useful results have been obtained.[16] The active principle of the metabolic products of many of the fungi and actinomycetes strains were extracted and chemically purified by the charcoal adsorption method. Some of the active substances were highly inhibitory to human pathogen both gram-positive and gram-negative and also to plant pathogenic fungi. Among the actinomycetes a strain of *Streptomyces* [Ac_6 (118)] was found highly active against *Eb. typhosa*. The purified antibiotic was thermostable and non-toxic as judged by the preliminary experiments with mice.

14 Ghosh, J. J. (1951), Science and Culture **17**, 42.

15 Ghosh, J. J. (1951), Science and Culture **17**, 135.

16 Ann. Report (1951), Bose Institute, Calcutta.

Sen and Nandi[17] reported the occurrence of antibiotic substances in the pinnae, stipe, and rhizomes of certain pteridophytes growing in and around Calcutta. Special mention should be made of the pinnæ of a species of *Adiantum* and *Nephrolepis* and of the rhizome of a sp. of *Drynaria*, the extracts of all of which were highly inhibitory to *Staph. aureus*. The inhibitory properties were dependent on (i) the season of collection, (ii) the habitat, (iii) the part of the plant used and the duration of its storage after collection and (iv) the method of extraction.

Sirsi, Gangadharam and De[18] studied the antibiotic activity of the extract of the fleshy part of the fruit of *Cucurbita pepo* against *Mycobacterium tuberculosis* and found that it is bacteriostatic at a dilution 1 : 10,000, while its action against *Staph. aureus* and *Strept. pyogenes* was very slight at the above concentration. They thought that the action is specific against acid-fast *Mycotuberculosis*.

Sirsi and coworkers[19] investigated the papyrographic separation of the active principle obtained from the leaves of *Toddelia aculeata*, a known specific for dysentery. It was demonstrated by the bioautographic technique that the substance had an absorption in the ultraviolet region.

Sirsi and De[20] tested several antimalarials (Quinine, Paludrine, Chloroquin, Camaquin) and P.A.S. for tuberculostatic properties and observed that all of them possessed definite *in vitro* activity which was entirely lost after 12 weeks. They noticed a temporary effect of the administration of quinine in incipient cases of tuberculosis and suggested that the action is due to tuberculostatic activity.

Rao and Verma[21] obtained three new pigments Morellins T. M. and L from the seeds of *Garcinia morella* whose antibacterial activities were studied against *M. Pyogenes*, *Staph. aureus* and against certain members of the enteric group.

17 Sen, S. and Nandi, P. (1951), Science and Culture, **16**, 328.

18 Sirsi, M., Gangadharam, P. R. J. and De, N. N. (1951), Curr. Sci, **20**, 297.

19 Sirsi, M., Venkatesh, D. S., Bheemeswar, B. and Sreenivasaya, M. (1951), Curr. Sci., **20**, 126

20 Sirsi, M. and De, N. N. (1951), Curr. Sci., **20**, 159.

21 Rao, P. L. N and Verma, S. C. L. (1951), Jour. Sci. Ind. Res. 10B. 184.

Mukherjee and Neelakantan [22] tested the activity of Allicin (Garlic Ext.) *in vitro* against certain test bacteria which were of veterinary and public health importance. It was significant that the substance was active against gram-positive and gram-negative bacteria and also against ærobes and anærobes.

Bhatnagar and Divekar [23] isolated the active principle pristimerin from *Pristimera indica* and tested its antibacterial activity against gram-positive and gram-negative bacteria. Its activity was of a low order and limited to the gram-positive in both *in vivo* and *in vitro* experiments. Clinical trials showed that the substance was beneficial against sore throat.

Investigations [24] carried out with a view to finding a suitable substitute for the corn steep liquor, an essential fortifying agent which promoted a 50-100 fold increase in the yield of penicillin, showed that the hydrolysates of the pupæ of the silk-worm and aqueous extracts of germinated green gram were very good substitutes for the corn steep liquor.

Venkatachala Murthy, Shankarappa and Sreenivasaya [25] showed that penicillin and streptomycin when adminstered to the larvæ of silk worms along with protein hydrolysates helped to bring about a definite and significant increase in the body weight of the larvæ varying between 2.5-6.8%. They suggested that these antibiotics exerted a beneficial influence in the control of the intestinal flora of the larvæ. It was reported later that aureomycin and chloromycetin also enhanced the growth rate of silk worms. Terramycin which was claimed to have improved the poultry, had relatively little effect on the growth of silk worms. Experiments with foreign races of silk worms susceptible to diseases showed that when the Japanese multivoltine race (N-112) was dosed with chloromycetin, the worms did not suffer from any of the diseases while among the untreated batches the disease incidence was 20%.

22 Mukherjee, R. and Neelakantan, P. R. (1951), Science and Culture **17**, 171.

23 Bhatnagar, S. S. and Divekar, P. N. (1951), Jour. Sci. Ind. Res. **10B**, 56.

24 Curr. Sci. (1951), **20**, 12.

25 Venkatachala Murthy, M. R., Shankarappa, B. S. and Sreenivasaya, M. (1951), Curr. Sci,. **20**, 269.

AUTHOR INDEX

	PAGE
Abhichandani, C. T.	13, 14
Abhyankar, U. S.	8
Acharya, B. N.	49
Acharya, B. G. S.	49
Acharya, K. T.	35, 37
Adams, R.	42
Agarwal, J. S.	36, 37
Agarwal, B. L.	74
Agarwal, R. R.	7
Ahuja, M. L.	71
Aibara, F. D.	97
Aiyadarai, S. G.	10
Anand, J. C.	59
Ananthakrishnan, C. P.	96, 100, 107
Anderson, R. K.	63
Andleigh, H. S.	75, 82
Asana, R. D.	19, 25
Asirvadam, M.	70
Ayyar, N. K.	104
Bagchi, S. N.	2
Balasubramanyam, M.	70, 71
Baliga, B. R.	55
Banerjee, B. N.	29, 30, 95
Banerjee, H. N.	43
Banerjee, S.	56, 59, 99
Banerjee, S. K.	70
Banker, D. D.	73
Baptist, N. G.	66
Barman, M. L.	70
Baslas, K. K.	38
Basu, J. K.	7, 9, 10
Basu, K. P.	95, 96, 100
Basu, S.	32
Basu, S. K.	9
Basu, S. N.	109
Basu Roy, B.	83, 84
Baxi, A. J.	55
Beri, R. M.	46
Bhale Rao, V. R.	100
Bhanacharya	94
Bhandar, P. R.	44
Bhandari, N. L.	94
Bharucha, F. R.	108, 109
Bharucha, F. D.	98
Bhatia, B. S.	58, 59
Bhatia, D. S.	59
Bhatia, B. B.	79
Bhatnagar, S. S.	44, 113
Bhatnagar, M. S.	47
Bhatnagar, V. B.	26
Bhatnagar, B. B.	16
Bhattachary, J. P.	109
Bhattacharya, B.	76
Bhattacharya, K.	76
Bheemeswar, B.	112
Bhide, B. V.	44
Bhoumik, A.	78
Bose, K. S.	70
Bose, A. N.	57
Bose, J. L.	45
Brahma Prakash	65
Broker, R. S.	89
Budhiraja, R. P.	46
Budhiraja, N. C.	37
Butlerbaugh, D. J.	42
Cama, H. R.	50
Carruth, F. E.	42
Chakravarti, D. (Mrs.)	43
Chakravarti, H.	85, 88
Chakravarti, I. B.	47
Chakravarti, J. K.	35
Chakravarthi, M. G.	64, 88, 91
Chakravarti, R. N.	43, 46
Chakravarti, S. C.	22
Chakravarty, A.	78
Chakravarty, M. K.	64, 80
Chakravarty, T.	44
Chanda, R.	49, 106
Chandran, K.	66
Chatterjee	13, 15
Chatterjee, A.	41
Chatterjee, B.	3
Chatterjee, K. D.	80
Chatterjee, R.	39, 40, 41
Chattopadhyaya, H.	59

	PAGE
Chaudhuri, D. N.	42, 43
Chaudhuri, R. N.	64, 80, 85
Choudhri, R. S.	26
Chowdhuri, D. K.	31, 52
Chaudhry, G. R.	43, 45
Chelam	9
Chinoy, J. J.	22
Chitre, R. G.	50, 54
Chopra, I. C.	40, 41
Clapham, H. M.	49
Clark, E. P.	42
Collins, F. D.	50
Craigie, J.	73
Dabadghao, P. M.	101
Daji, J. A.	8, 11
Dakshinamurti, C.	17
Dalvi, P. D.	49
Damodaran, M.	66, 110
Daniel, F. L.	8, 9
Das, A.	90
Das, B. B.	13, 46
Das, S. C.	1
Das, T. M.	24
Das Gupta, C. R.	76
Das Gupta, N. C.	104
Dastur, N. N.	95, 99
Dastur, R. H.	19, 23
Datta, A.	41
Datta, C.	19, 20, 27, 56
Datta, N.	7
Datta, P. (Jr.)	52
Datta, P. C.	42, 43
Datta, S.	3, 94
Datta, S. C.	41
De, H. N.	50, 52
De, N. N.	80, 112
De, R.	18, 19
De, R. M.	3
De, S. P.	54
De, S. M.	72, 76
De, S. S.	50, 100
Deb, C.	56
Deb Goswami, M. N.	101, 102
Desai, S. V.	11, 12
Deshapande, S. S.	38
Deuel, H. J. (Jr.)	48, 54
Devadas Rajammal, P.	61
Dey, B. B.	69
Dey, N. C.	74
Dhar, D. C.	34
Dhar, M. L.	34
Dhar, N. L.	44
Dhar, N. R.	12
Dharmendea	74
Dhawan, C. L.	16
Dhayagude, R. G.	73
Dhekne, V. V.	44
Dhingra, D. R.	38
Dhingra, D. N.	38
Divekar, P. N.	113
Divekar, P. V.	44
Dogra, J. R.	90
Doraiswamy, T. R.	63
Doraswami, L. V.	23
D'Sena, G. W. L.	70
D'Silva, C. B.	75
Dubash, P. J.	108
Dunn, M. S.	53
Dutta, A. T.	45
Dutta, B. N.	85
Dutta, S. C.	77
Elvehjam, C. A.	54
Esh, G. C.	51
Fatterpaker, P.	53, 54
Felix, A.	73
Friedmann, H. C.	69
Gajendragad, R. S.	9
Gandhi, R. T.	101
Gangadharan, P. R. J.	112
Ganguly, J.	48
Gaitonde, M. K.	66
Ganjoo, T. N.	38
Gault, E. W.	70
Geden, J.	41
Ghidyal, N. P.	12
Ghorpure, P. V.	78
Ghosh, J. J.	111
Ghosh, K. K.	74
Ghosh, R. K.	82
Ghosh, S. M.	78

	PAGE
Giri, K. V.	33, 67
Girdhari Lal	57, 58, 59
Goel, L. N.	81
Gopalakrishna, B. N.	97
Copalakrishnan, V.	65
Gopalan, C.	81
Gour, K. N.	84
Govindarajan, S. V.	15
Goyle, A. N.	86
Guha, B. C.	68
Guha, B. P.	19
Guha, M. P.	20, 39, 40
Guha, P. C.	38
Guha Sircar, S. S.	43, 44
Gulati, K. C.	38
Gunnery, K. S.	98
Gupta, A. C.	37
Gupta, A. S.	37
Gupta, G. N.	38
Gupta, J. C.	45
Gupta, S. C.	36
Hamid, A.	79
Handa, K. L.	40, 41
Harihara Iyer, C. R.	13
Henderson, L. M.	51
Hirwe, R. N.	66
Idnani	14
Innes, R. F.	17
Isaiah, P.	70
Iya, K. K.	92, 97, 98, 99
Iyengar, G. S.	23
Jagjiwan Singh	16
Jain, N. L.	58, 59
Jamwal, K. S.	41
Janardhan	36
Jiwan Singh Pruthi	57
Kalra, S. L.	74
Kalyanakrishnan, M. G.	96, 107
Kane, J. G.	36, 37
Kannan, A.	96, 100
Kapoor, L. D.	40
Kapur, P. N.	85
Kashinathan, S.	6
Karunakar, P. D.	8, 15
Kaur, R.	24
Kaushal, R.	108
Kehar, N. D.	101, 104, 105
Khambatia, J. G.	99
Khare, N. P.	97
Kibe, M. M.	11
Klaveren, F. W. von	54
Kodicek, E.	52
Koe, B. K.	48
Kohnke, H.	8
Konar, N. R.	53, 76, 85
Kothiyal, M. D.	8, 10, 12
Krishna Iyengar	26
Krishnamurti, K.	108
Krishnamurthy, S.	47
Krishnaswamy, M. A.	99
Rrishnan, K. V.	71
Krishnan, P. S.	31, 32
Krishna Rao, C.	93
Krishnaswamy, N.	68
Krishnaswamy Rao, S.	63
Lahiry, D.	84
Lakshminarayan Rao, M. V.	63
Lal, K. N.	18, 19, 20, 26
Lal, S. B.	65, 66, 81
Lalchand Dharmani	14
Lalitha, K. R.	95
Latif, K. A.	43
Laxminarayana, H.	97
Lohara, Kartar Singh	14
Lokre, R. J.	64, 89
Luktuke, S. N.	94
Luthra, P. N.	86
Macmillan, W. G.	47
Magar, N. G.	66
Majumdar, D. N.	43
Malaviya, B. B.	79
Mallik, A. K.	25
Mathur, P. B.	58
Mathur, K. S.	83
Marfatia, V.	52, 53
Majumdar, D. C.	81
McNaught, M. L.	106, 49
Meenakshi, V. R.	56

	PAGE
Mehl, J. W.	48, 64
Mehrotra, J. N.	38
Mehrotra, B. S.	110
Mehta, R. L.	47
Menon, K. P. V.	21
Merchant, G. V.	70
Miller, R. F.	42
Misra, A. L.	36
Misra, G.	21
Mitbander, V. B.	55
Mitchell, H. H.	106
Mitra, C.	42
Mitra, H. N.	80
Mitra, J.	20, 56
Mitra, M. K.	46
Mitra, R. P.	1, 2
Mitra, S.	64, 88
Mitra, S. N.	86
Mittal, V. N.	91
Modi, B. G.	89
Moorjani, M. N.	59
Morton, R. A.	49, 50
Moses, L.	25
Mukerji, B.	54
Mukherjee, C.	84, 89
Mukherji, D. K.	27
Mukherjee, J. N.	2, 7
Mukherji, K. L.	81
Mukherjee, R.	94, 105, 106, 113
Mukherji, S.	32, 37, 46, 65, 100
Mukherjee, S. K.	2, 3, 4, 5, 7, 11, 104, 108
Murty, K. S.	42
Murthy, G. K.	95
Nadkarani, B. Y.	50
Nadkarani, S. M.	89
Naganna, B.	31
Naidu, B.	35
Naidu, V. R.	63
Nambudripad, V. K. N.	98
Nanda, K. K.	22, 32
Nanda, P. N.	92
Nandi, S. P.	32
Nandi, D. L.	64
Nandi, P.	112
Nandi, P. N.	108
Narasinga Rao, M. S.	2, 26
Narayan, D.	94
Narayan, T. R.	13
Narayana, N.	8
Narayana Rao, D.	68
Nayak, U. G.	38
Nazir, B. N.	41
Neelakantan, P. R.	94, 113
Neelakantan, S.	45
Nevgi, G. V.	28, 30
Om Prakash Ram, A.	65
Oommen, Thomas P.	47
Osmani, Z. H.	110
Owen, E. C.	49, 106
Pandalai, K. M.	21
Pandit, S. R.	71
Panigrahi, G.	22
Patel, M. K.	11
Patel, S. M.	48, 64
Pathak, A. N.	11
Patil, H. B.	71
Patna, J.	82
Patwardhan, N. N.	52, 67, 81
Pal, R. N.	98
Paul, T. M.	96, 100, 107
Pavgi, M. S.	110
Pereira, A. F.	89
Phadnis, J. S.	36
Pillai, S. C.	12, 13
Pillai, D. K. P.	36
Pirzada, M. A.	85
Pithawala, H. R.	110
Pradhan, V.	50
Prasad, S.	65
Prasad, A. L. N.	33
Pritam Singh	99
Puntambekar, S. V.	67, 100
Puri, B. R.	7, 99
Puttaswamy, C.	94
Radhakrishnan, G. B.	98
Rajagopalan, R.	13
Rajagopalan, V. R.	94
Ramachandran, K.	110
Ramachandran, M.	67

	PAGE
Ramachandra Rao, P.	67, 100
Ramakrishnan C. V.	28, 29, 30, 51, 95
Ramakrishnan, T.	68
Ramamoorthy, B.	1, 16, 17
Rananavre, M. N.	75
Ramasarma, G. B.	51
Ramasastri, B. V.	52
Ramaswami, G. V.	37
Ramiah, R.	13
Ramiah, K.	14
Randive, G. M.	37
Rangachari, P. N.	45
Ranganathan, G.	52
Rangaswami, S.	43, 45
Ramaswamy, M. C.	94
Ranjan	8, 10, 12
Rao, B. D. F.	85
Rao, K. N. A.	74
Rao, P. K.	25
Rao, P. L. N.	42, 112
Rao, P. S.	39, 46
Rao, V. S.	43
Rao, M. S. S.	19, 20
Rao, M. V. L.	52
Rao, S. N. S.	37
Ray, G. K.	45
Ray, H. N.	94
Ray, S. C.	98
Raychaudhuri, S. P.	5, 9, 10
Reddy, D. J.	79
Reddy, K. K.	33, 51, 52
Rege, D. V.	55
Rege, N. D.	9
Roberts, E. A. H.	26, 66
Roy, A.	94
Roy, A. R.	77
Roy, B. B.	1, 3, 15
Roy, D. K.	31, 68
Roy, D. M.	63
Roy, J. K.	50
Roy, P. K.	45
Sadana, J. C.	60
Sadasivan, T. S.	109
Sadasivan, V.	30, 68
Saha, H.	90
Saha, S. K.	41
Sahai, K.	104
Sahasrabudhe, M. R.	52, 67
Saletore, S. A.	37
Samrath, K. D.	55
Sampath Kumaran, J. D.	93
Sankaran, G.	61
Sankarasubramony, H.	21
Sarkar, J. K.	72
Sarkar, S. N.	64
Sarma, P. S.	52, 55, 67
Sarojini, J. S.	109
Sathe, V. (Miss)	50
Satyanarayana, K. V. S.	6
Satyanarayana, M.	15
Savur, C. R.	110
Saxena, J. S.	104
Sen, A.	13
Sen, K. C.	96, 107
Sen, N. C.	70
Sen, N. K.	35
Sen, S.	112
Sen, S. N.	75
Sen, S. P.	21, 35, 108
Sen, S. K.	39
Sengupta, A. C.	43
Sengupta, K. P.	76
Sengupta, P. C.	76
Seshadri, T. R.	42, 45
Shankarappa, B. S.	113
Shankarasubramanian, S.	45
Shanks, G.	80
Shanmuga Sundaram, E. R. B.	52
Sharma, P. G.	37
Sharma, V. N.	36, 43, 44, 45
Sharma (Miss)	79
Sheriar, K. C.	108, 109
Shet, S. W.	49
Shrikhande, J. G.	11, 104
Shiva Rao, H.	6
Shri Ranjan	24
Shrivastava, D. L.	34
Siddiqui, S.	43, 45
Singh, Balbir	86, 87
Singh, B. P.	47
Singh, I. S.	22

	PAGE
Singh, K.	40
Singh, L. B.	25
Singh, S.	43
Singh, S. N.	25
Sircar, S. M.	21, 24
Sirsi, M.	74, 90, 112
Sirur, S. S.	7
Sitharaman, C.	94
Sivaraman, M. S.	14
Siva Shankar, D. V.	55
Sohonie, K.	66
Soman, S. V.	108
Srinivasa Murthy, V.	96
Sreenivasan, A.	52, 53, 54, 55, 56, 110
Sreenivasaya, M.	112, 113
Srinivasachar, S.	84
Srinivasan, K. S.	51
Srinivasan, M.	65
Srinivasan, M. R.	98
Srinivasa Pai, K. V.	13
Srivastav, P. C.	54
Srivastav, P. V.	37
Srivastava, B. P.	104
Srivastava, H. C.	46, 65
Srivastava, S. P.	104
Subramaniam, K. N. A.	91
Subramanian, N.	65
Subramanian, S. S.	110
Subrahmanyan, V.	63, 67
Subbiah, B. V.	11, 15
Subbarao, M. S.	26
Sunder Rao, A. R.	63
Sutton, T. S.	61
Swamy, T. V.	91
Talapatra, S. K.	102
Talati	12
Tamhane, R. V.	6
Tayal, J. M.	35
Teotia, S. S.	25
Tewari, J. D.	36
Thomas, B.	15
Thomas, E.	70
Tribedi, B. P.	72, 77
Tulpule, P. C.	52
Uppal, I. S.	47
Vachani, M. V.	14
Varadarajan, S.	9
Varier, N. S.	38
Varma, B. S.	39
Varma, K.	97
Varma, S. C. L.	112, 42
Veeraraghavan, N.	75
Veliath, G. D.	84
Venkatachala Murthy, M. R.	113
Venkatappiah, D.	100
Venkataraman, K. V.	71
Venkataraman, P. R.	55
Venkataraman, K.	68
Venkatram, C. S.	13
Venkataratnam, L.	27
Venkitasubramanian, T. A.	50, 95, 100
Venkatesh, D. S.	112
Venkateswara Rao, R.	95
Venkateswaralu, P.	68
Venugopal Rao	3, 5
Verghese, J.	38
Verma, A. B. S.	8
Verma, H. C.	98
Vidyarthi, N. L.	36, 37
Vijayaraghavan, P. K.	53
Viswanath, B.	1
Wadha, N. D.	101
Wahi, P. N.	83, 87
Wandrekar, S. D.	56
Wareham, J. F.	46
Wariar, U. A.	25
Warnae, J. M.	95
Weinstock, I. M.	51
Wig, K. L.	83
Williams, J. N. (Jr.)	54
Wood, D. J.	26, 66
Yadav, B. S.	20
Zechmeister, L.	48
Zubairy, A. W.	104

SUBJECT INDEX

	PAGE
A*cacia cateshu* resin	47
Alkaloids from plants	39-41
Amaranthus panniculatus, biological value of	65
Amino acids estimation	66, 67
Amoebiasis	77, 78
Amylase	31, 32
Anemia	85
Animal nutrition	101-107
Antibiotics	111, 112
Antimalarials	112
Apyrase	32
Argemone oil	64, 65
Bacterial diseases	71-75
Bauhima variegatte, nutritive value of	101
Berseem	104
Biological value calculation	105, 106
Biotin	55, 56
Blackwater fever	76
Blastomycosis	82, 83
Blood composition	64, 85, 86 88-91
Butter	99, 100
Butterfat	68, 100
Carotene digestibility	106, 107
Casein	62, 67
Cattle breeding	93-95
Cholera	71-73, 90
Choline	31, 59
Cirrhosis	83-85
Clays	1-5
Clinical pathology	85-91
Coliform bacteria in milk	97
Colouring matter in plants	41, 42
Compost	12
Dairy science	92–100
Deficiency diseases	79-82
Egg, supplementary value of	61
Enteric-fever	86
Enzymes	28-33, 96
Epidemic dropsy	64, 79-81
Essential oils	37-39
Esterase	28, 31
Fat from	
Actinodaphne hookeri	36
Terminalia balerica	35
Fats, keeping quality of	32
Fats, nutritive value of	67, 68
Febrile infections	91
Fertilizers	12-16
Fluorine estimation	68
Folic acid	52-55
Food surveys	61, 63
Food technology	57-60
Fungi	109-111
Grasses	
Eraianthus longsetosus	103
Hymenachne amplexicaulis	102
Imperata arundinacea	102
Indigenous	102, 103
Leersia hexandra	103
Microtegium ciliatum	103
Oryza sativa	102
Phalaris minor	101
Saccharum munja	104, 105
Haemoparasitic diseases	76, 77
Human nutrition	61-69
Human pathology	70-91
Hyperthyroidism	105
Infantile cirrhosis	63
Intestinal parasites	77-79
Jaman seeds for feeding cattle	104
Kaolinite clay	1-3
Lactalbumin	62
Lathyrism	63, 64
Lathyrus sativus	64
Leishmeniasis	76, 77
Leprosy	74
Lipase	28-30
Malnutrition in children	81

	PAGE
Manures	12-16
Milk :	
Changes during souring	99
Fluorescence of	95
Human	49
Legal standards	99
Methods of analysis	99
Microflora	97, 98
Nutritive value	98, 99
Preservation	97, 98
Processing	98
Refractive constant	95
Trybutyrinase	96
Vitamins	95, 96, 107
Niacin	51-52, 95
Nitrogen fixation	11
Nutrition, animal	101-107
Nutrition, human	61-69
Nutritive value of foodstuffs	65, 66
Oils, composition	
Aegle marmelos	38
Annona squamosa	55
Atlanta monophylla	37, 38
Corchorus olitorius	34
Emblica officinalis	34
Ipomoea muricata	36
Lemon grass	38
Mallotus phillippinensis	36
Ocimum killimands-charicum	38
Peppermint	38
Pinus longifolia	39
Pongamia glabra	36
Tobacco seeds	36, 37
Oil refining	37
Penicillin	112
Phosphatases	30, 31, 100
Plants :	
Alkaloids	39-41
Bitter principles	42, 43
Colouring matters	41-42
Composition	26
Effect of light	21-24
Growth regulators	24, 25
Mineral nutrition	18-21
Physiology	18-27
Pigments	27
Products	34-47
Vernalization	22
Water relations in	25, 26
Plasma proteins	88
Polygalacturonase	110
Potatoes	58, 59
Pregnancy	84, 89
Protein metabolism	66, 67
Rabies	75, 76
Rancidity	32, 37
Relapsing fever	74, 75
Riboflavin	50, 95
Rinderpest	94, 95
Saponin	47
Seeds, viability test	27
Sewage effluents	12
Soils :	
Classification	5-9
Conservation	9-10
Electro-chemical properties	1
Microbiology	10-12, 108, 109
Moisture	8
Physico-chemical properties	7, 8
Reclamation	9, 10
Survey	5-9
Trace elements in	16-17, 103
Spore formers in milk	97
Streptomycin	112
Sugarcane tops as cattle feed	104
Syphilis	87, 88
Thiaminase	33
Thiamine	50, 51, 95
Tributyrinase	96
Tripsin inhibitor	66
Tropical *Eosimophilia*	82
Tuberculosis	74
Typhoid	73, 74
Virus diseases	75, 76
Vitamin A	48-50, 96, 107
Vitamin B_{12}	52-55, 63
Vitamin C	56-58
Zinc, lipotropic activity of	68

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